THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XI. Nº 250—14th YEAR.] LONDON, MAY 20, 1862. [Subscription { 15s. in Advance / 18s Credit } DOUBLE No. Price 1s.

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500 Tons during December and January next.

Tenders to be sent to the Office of the Company, TUNBRIDGE WELLS, by Six o'clock, p.m., on Wednesday, the 4th of June next, marked "Tender for Coals," and addressed to the SECRETARY, of whom any further particulars may be ascertained.

The Directors reserve to themselves the power to reject any Tender.

By order, JOHN HEAD, Sec.
Tunbridge Wells, May 16, 1862.

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ON SALE, at the Gas Station, Rochdale Road, the following HYDRAULIC MAINS, U-shaped, 21 in. deep by 18 in. wide:—Thirty-six Pipes, 7 ft. 5½ in. long; Fourteen Pipes, 7 ft. 3 in. long. Each of these lengths is prepared with five branches, for the reception of Dip-pipes.

Also, Seven Exit-Lengths, 9 ft. 4 in. each; and Fifteen Blank Flanges, to correspond.

May be seen on application to Mr. HENRY LYON, the Manager of the Station.

Tenders for the whole, or portions thereof, to be addressed to the Gas Committee, York Chambers, King Street, MANCHESTER.—By order,

JOSEPH HERON, Town-Clerk.
Gas Offices, York Chambers,
King Street, May 9, 1862.

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(SUCCESSORS TO GEORGE B. LLOYD & CO.,)
GAS STREET AND BERKLEY STREET,
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Manufacturers of Wrought-Iron Tubes and Fittings,
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THREE
MEDALS AWARDED TO
THOMAS GLOVER'S
PATENT DRY GAS-METERS.

LORD REDESDALE'S "SALE OF GAS ACT."

DRY METERS *VERSUS* WET METERS.

LONDON, February 25, 1861.

THOMAS GLOVER begs to call the attention of Gas Companies and others to a few *facts*, which, if duly considered, must lead to most important conclusions:—

1. That since THOMAS GLOVER commenced to manufacture his Patent Dry Gas-Meters (which is now upwards of 15 years), every Wet Meter Maker of any importance in England has been compelled to manufacture Dry Gas-Meters; and in the JOURNAL OF GAS LIGHTING, of date of 12th of February, 1861, Messrs. William Parkinson and Co., successors to the late Samuel Crossley, advertise that they "intend manufacturing *Dry* as well as" Wet Meters, and it is worthy of particular notice that they intend to do so "after 40 years experience in manufacturing Wet Gas-Meters of such a quality that has enabled them, as they say, to maintain a superiority over all other; and this, be it also particularly noticed, after they had advertised in the JOURNAL OF GAS LIGHTING, January 29, 1861, "their improved low-spouted Gas-Meter with new patent float arrangement, which entirely overcomes the difficulty experienced by ordinary Wet Meter."

2. That it is quite consistent with THOMAS GLOVER'S knowledge that Wet Gas-Meters, called "low-spouted" or "compensating Wet Meters," have already been proved to be incapable of continuous working or registration, and for this reason the manufacturers of these Meters have been induced to seek the repeal of Lord Redesdale's (righteous) Sale of Gas Act.

3. That every year the Patent Dry Gas-Meter manufactured by THOMAS GLOVER has risen in favour with Gas Companies and Gas Consumers, placing him in the proud position of being the largest manufacturer of Gas-Meters in the country.

THOMAS GLOVER guarantees his Patent Dry Gas-Meters to meet all the requirements of the "Sale of Gas Act," to give accurate and unvarying registration with steady lights; and, from their peculiar construction, cannot be tampered with, and may be fixed in open situations even above or below the level of the lights. They work with less pressure than Wet Meters, and are not affected by the most severe frost.

THOMAS GLOVER guarantees to uphold all Meters sold by him for 5 years free of expense to the purchaser, or for a trifling per centage per annum will contract with any Gas Company to uphold their Meters of his manufacture for a series of years; and, at the conclusion of such contract, to leave the Meters all in perfect working order.

N. B.—Agents in several parts of England are wanted. Apply by letter, or personally.

WILLIAM PARKINSON AND CO.

(SUCCESSORS TO SAMUEL CROSLEY),

PATENT WET AND DRY GAS-METER MANUFACTURERS, &c.

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Established 1816.

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W. P. and Co. invite especial attention to this Meter, which entirely overcomes the difficulty to which ordinary Wet Meters are subjected, owing to the short range of the Float, which is necessary, in order to meet the requirements of the Sale of Gas Act.

"It is well known that in Meters constructed so that the valve will close when the water is drawn off to such a point as to render them 3 per cent. slow the lights are liable to be extinguished by the closing of the valve by a sudden increase of pressure. To meet this difficulty, Mr. Pinchbeck has invented an ingenious and simple arrangement by which the action is reversed, and any such increase of pressure, in his Meter, raises the value instead of depressing it. The fact of the improvement having been adopted by Messrs. W. Parkinson and Co. is a sufficient guarantee that it practically and effectually remedies the inconvenience it is designed to meet."—JOURNAL OF GAS LIGHTING.

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Which can be seen at all the London Gas-Works. Also Liverpool, Manchester, Sheffield, Nottingham, Belfast, Glasgow, Birmingham, Dublin, Bristol, Leeds, Leicester, Brighton, Southampton, Sunderland, Wolverhampton, Bradford, Norwich, &c., &c.

TEST GASHOLDERS, EXPERIMENTAL METERS, EXHAUSTER REGULATORS,

MINUTE CLOCKS, PRESSURE GAUGES, PHOTOMETERS, PRESSURE REGISTERS, &c.

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TO CORRESPONDENTS.

W. D.—*The atmospheric air contained in gas may be determined by ascertaining the quantity of oxygen present, by means of a solution of pyrogallic acid, and multiplying that quantity by 5, the proportion of oxygen in the composition of atmospheric air being, in round figures, one-fifth of the whole bulk.*

NOTICES.

The subscription is 15s. per annum, if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, in July and January of each year. Post-Office orders must be made payable at the Charing-Cross Money-Order Office, to William H. Bennett, No. 42, Parliament Street, Westminster.

The next number will be published on Tuesday, June 3, and the subsequent numbers on each successive alternate Tuesday.

This JOURNAL has been duly registered at the General Post Office for transmission abroad.

All Communications to be addressed to the Editor, No. 42, Parliament Street, Westminster; and orders for Advertisements to the Publisher, Mr. W. B. King, No. 11, Bolt Court, Fleet Street.

THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

[*TUESDAY, MAY* 20, 1862.

Notes upon Passing Events.

DR. BRADY'S Utilization of Sewage Committee has recommenced its sittings, but seems very hard up for witnesses—that is to say, witnesses who will say what the chairman wants. Mr. King was, he says, a farmer 26 years ago, and is now a contractor for carrying out the catch-water system of sewage irrigation at lunatic asylums and other public establishments. It should be remembered that, 14 years ago, a whole series of Board of Health reports were got up to show that pipe and hose was the only true plan of irrigation, and that the old Italian and Devonshire system ought to be abandoned. See Inspector Lee's reports on Exmoor in 1846. But pipe and hose having been found too costly, the cheap, simple irrigation of Lombardy again comes into fashion. Mr. King knows nothing agriculturally, except what he has been told; he is neither a farmer nor an agricultural chemist, but a decent man, no doubt laudably anxious to extend his business connexion and lay "carriers" for all the lunatic asylums in the kingdom. After repeating some of the stereotyped stories which are regularly supplied to every Chadwickian witness, Mr. Paget, who has learned something about the money value of sewage at Leicester, cross-examined him in the following damaging manner:—

Mr. PAGET: Will you give us the grounds upon which you say that at 2*l.* per ton it would pay?

Witness: Because it produces a certain quantity of grass with a certain quantity of sewage; and I have made calculations to show that it would work out that.

Mr. PAGET: Can you give us those calculations? You have said that 2000 tons of sewage might be applied per acre, and that 2*d.* per ton would be a fair price to pay for it—that is something like £17. In what way would you make the application of £17 worth of sewage per acre pay the farmer, because to that is to be added the expense of your engineering plant, &c.?

Witness: The extra crop of rye-grass during the first two years would be sufficient to pay it. I have seen the works at Lochend. I do not know the circumstances attending it there.

Mr. PAGET: I will tell you. In the first place, the land was ploughed and tilled for an early crop of potatoes, exceedingly liberally manured; and, the potatoes being dug up, the land was sown with Italian rye-grass. It then, if I remember right, had guano in addition, and then the application of sewage. Now, do you know what would be the produce of the land without the manure in rye-grass treated in that way?

Witness: I could not say exactly; it would not be anything like so much.

Mr. King estimates the cost of draining and pumping at Brighton, so as to lay the sewage on the land, at £90,000. We have not the slightest confidence in the off-hand estimates of a sort of "Butty contractor;" but we may fairly ask again, why the committee do not call Mr. Rigden, the greatest farmer, and also, at one time, the greatest consumer of town-manure near Brighton, and ask him whether he would give 2*d.* a ton for Brighton sewage? because, if he would, the committee would get what they so far want—a real responsible customer for the liquid nuisance. Until Dr. Brady calls Mr. Campbell, Mr. B. Congreve, and Mr. Rigden, who really do know something practical about sewage, and, as long as he fills up the time of his committee with such evidence as that taken on the 5th of May, we shall set him down as a mere case manufacturer, fishing for evidence to sustain foregone conclusions. The opinions of such a person as Mr. King on agricultural questions are absolutely worthless. The same may be said of the small talk about China of the Boanerges of Brighton, Mr. White, M.P. All he told the committee has been told—and much better told in print—by travellers and gardeners, in a dozen books and articles, during the last twenty years. No sane man believes that even if our noses were case-hardened to a Chinese condition, we could compare what they do with their labour at 1*d.* a day with our labour at 2*s.* a day. Mr. White might just as well have lectured on Chinese duck rearing, and recommended a colony of duck-feeding boatmen on the Thames between Chelsea and Richmond. Colonel Fane did get tired at last, and objected that "all this has nothing to do with the question before the committee—which is, whether sewage is applicable in England?" To which, with wonderful candour, Mr. White replied; "Understand, I have nothing *to prove* by making these statements." In a word, his chat about China was very fit for a lecture to his constituents, but quite out of place in the House of Parliament, if Dr. Brady's inquiry were really serious.

From Sir Joseph Paxton, an original and practical man, we expected something true, if not new; but his evidence is rather an abstruse essay on the philosophy of plants, than a contribution towards the use of sewage. In plain terms, we can make neither top nor tail of the horticultural and architectural knight's conversation with Dr. Brady. That a bamboo cane watered with hot water will "grow ten inches in one day" is a curious fact, but does not seem to have much to do with the sale of the contents of the London sewers. After talking away, in a manner that, we have no doubt, was vastly pleasant to hear, about the Crystal Palace, the agriculture round Ghent,

in Flanders, and the irrigation of a valley fifty miles long, near Valentia, in Spain, but which reads rather oddly and disjointedly, Sir Joseph ended where we began—viz., "that it would take a large capital to apply the London sewage; and, although you find capitalists to go into various schemes, in all quarters of the world, yet you would not find them ready to enter into any speculation for selling the sewage of London."

As the committee seem about to call witnesses with schemes yet untried for making millions out of muck, its labour may last for weeks—

"And, like a wounded snake, drag its slow length along"—

until the end of the session; we are not surprised that Colonel Fane should have grown impatient when that eminent wielder of the scissors and paste-brush, Mr. Cuthbert Johnson, F.R.S., ex-chairman of the Croydon Board of Health, was girding up his loins to relate, for the nineteenth time, the result of experiments on a quarter of an acre of lawn, with the help of the domestic slop-pail, in producing crops, which were carried away in the gardener's wheelbarrow, and consumed by one of the donkeys living on the premises. These experiments have already been the subject of several essays by Mr. Cuthbert Johnson, in agricultural newspapers and magazines; they have been embodied in a report to the ex-Board of Health; republished, at the expense of that body, in a pamphlet; and re-circulated, in a speech at the Royal Farmers Club, by this indefatigable manufacturer of scientific shoddy.

A recently-issued excerpt from the proceedings of the Institution of Civil Engineers, contains a report of the discussion "On the Rise and Fall of the River Wandle," under the section "Pollution of Rivers"—information which ought to be considered by Dr. Brady's committee, before they make their report. It is stated that the sewage of the 70,000 inhabitants of Leicester has been purified at a cost of £40,000 for plant, and at an expense varying from £1500 to £2500 a year. M'Dougal's fluid—each gallon of which costs 8d., and purifies from 12,000 to 15,000 gallons—would deodorize liquid sewage, without lowering its manurial qualities. This fluid is the second product of distillation of gas-tar, at a low temperature. In the first distillation, naphtha is produced; in the second, a fluid which, being rendered alkaline by a little quicklime, possesses the deodorizing power. It was stated, in the course of the discussion, that the cost of the works at Rugby and at Watford equalled, if they did not exceed, the value of the improvement of the land. This is not a reason for refraining from such works, but for avoiding promises of great profits. The Croydon treatment—of first straining away the solid matter, to be sold at a nominal price; then, when necessary, as in warm weather, deodorizing the liquid with M'Dougal's fluid; and then distributing it over well-drained fields of suitable extent—seems the most complete arrangement extant. Good grass-crops are obtained, and nuisance is considerably abated. Mr. C. Greaves described the difficulties, carefully suppressed by the Board of Health reporters, which absorbed £50,000, the capital of a company founded at the instigation, or, at any rate, under the encouraging reports of Mr. Chadwick's pupils in 1846. "The sewage was as rich as any that could be found; the stench was so strong and pernicious, that no one could remain long in the engine-house. The grit that came with the sewage was a source of great inconvenience, destroying the valves of the pumps with extraordinary rapidity; and, when the pipes were taken up, the main, 16 inches in diameter, was found to be half filled with sand for the first half mile. Great difficulty was experienced in preventing the deposit of fine matter in the distribution-pipes. The destruction of hose-pipes was enormous. Upon an average of twelve months, a hose lasted only seventy days, and, in some cases, did not last a month. Owing to the sewage being largely impregnated with salt, it was impossible to dry the hose; and the cost of that article alone was more than the rent received from the farmers. . . . *The company had been misled by some fancied analogy with the Edinburgh meadows. There the sewage was brought down to the meadows with scarcely any cost, in a small channel, by gravitation. By merely cutting a sod, the required quantity of liquor was obtained, and the supply as easily cut off; the surplus, if not wanted, escaping to the sea!*" Mr. Greaves considered that the benefits were not sufficient to remunerate an extravagant outlay and an expensive system. In situations where expenses would be moderate, or the crops forced bore an unusual value, he had little doubt but that irrigation with sewage-water might be profitably worked.

The farmers—no, not the farmers, but the London Farmers Club—have been discussing "The Expenditure of County-Rates." The author of the paper—who is not a farmer, but secretary of the club, and one of the editors of an agricultural newspaper, advocated the transfer of the county expenditure from the county justices to an elective financial board. He complained that county-rates and county expenses were the only accounts that could not be questioned by the people who paid them; that the county-rate was so mixed up with the poor-rate that it required a professional accountant to separate the items; that formerly the gaol-rate, levied under that name, could be deducted from the rent, but that now it was so muddled up with the poor-rate, that farmers grinned, grumbled, and paid in despair. He insinuated that farmers were taxed in order to treat county magistrates to the amusement of building palaces in the shape of prisons and lunatic asylums; that a rural police was an excuse for providing for well-born or well-married half-pay officers; that the private policemen were chiefly occupied in looking after the magistrates demesnes, and were likely to be employed in collecting statistics and preserving game; and, finally, he came to the conclusion that the best reform would be to separate the judicial and financial duties of the J.P.'s, and intrust the latter to an elective board. The following are the most illustrative passages of a very amusing paper, which was, however, singularly anonymous in its facts; and for good reasons—every farmer who sent a story of a county-rate grievance, desired that his name and place should be "kept dark."

A reverend gentleman, who would call in a real man of business to aid him in building a greenhouse or planning a school-room, will feel himself thoroughly qualified to give orders for 30 or 40 thousand pounds worth of bricks and mortar when he has nothing to pay for them. The man of large possessions, were he about to build, on his own account, a homestead, a barn, or a stable, he would be pretty sure to consult not merely the architect, surveyor, or builder, but the practical man of his district—the ratepayer, in fact, who would advise him how to lay out his money to most advantage, the plan to adopt as best suited to his object, and the contract to accept. Let us look to a few such modern instances. It is, then, but within this year or two, that a number of visiting magistrates in one of the home counties turned their best attention to the condition of a lunatic asylum. They touched it and retouched it at one visit; they enlarged and amended at the next; they amended and enlarged on their third call, and did something more at a fourth. This went on until the common people—the mere ratepayers—were fairly puzzled. "Surely," they said, "after all that has been done, the good gentlemen must be going to live there themselves." Their worships did not, however, proceed to this; but they paid the asylum one further official visit of inspection; and, having done so, they agreed that it was impossible to do anything more to it; it was as complete as they could make it—and then they resolved to make another! The old asylum, after the endless sums spent in amending, was sold for what it would realize—and a madhouse is not the kind of mansion to fetch a fancy price—while the county has to find the difference for building a new one. . . . In a case that has recently occurred in a county running right into London, the magistrates there borrowed, as they were amply qualified to do, a pretty round sum for building and so forth, at something like 5 per cent. After, however, they had got the money, they found they should not need it for some time to come, and so they lent it out again, on good security, at somewhere about 2½ per cent. They consequently stand at present in this somewhat remarkable financial position—they have a lot of money by them, and the longer they keep it, the more will they lose by it! In Worcestershire, where the county rate is fearfully high, the gaol chapel has been pulled down, and built up again, three or four times in the experience of one man. "The original debt," as it is called in the balance-sheet of the county—the original debt of that pet plaything of a prison at Reading, was £42,000; and now, to back this, the magistrates have built a new county hall in the same town, at an estimate of £13,000, but with an actual expenditure of more than £20,000. The new police-stations in the same happy county are as much overdone, as, indeed, they have been in many others. In Cornwall, for example, these buildings will cost the county £40,000; that at Wadebridge is over £11,000, while they have to pay another £40,000 for a new gaol, pulling down a very good one that cost £20,000, which, with an additional outlay of another £10,000, would have answered every purpose. So that, in the matter of this one building, the ratepayers consider and maintain that about £30,000 has been wantonly thrown away. Of course, the Cornishmen have petitioned, as well they might. The Wiltshire Lunatic Asylum was built at a first cost of somewhere about £52,000, but there is still a new wing now to be added. The militia stores of the same county took £7500, but, with the residences yet to be built; while stabling for policemen's horses, and carriage-houses for policemen's coaches, are worked up in a style that few of the luckless ratepayers would ever venture on for their own humble equipages.

There cannot be a doubt that the author could have given, if he had pleased or dared, facts and names, dates, and places, that would have filled pages, and strengthened his arguments amazingly. But he did not, for the same reason that scarcely one farmer supported him by word of mouth, although probably they applauded vehemently; cheers are anonymous assent. The chairman, a farmer, did speak out, and so did one other Bedfordshire farmer, with a lease; but the rest sat mute, and left the task of defending representative institutions from the eloquent attack of a county treasurer and magistrate's clerk, to a Yorkshire implement-maker and a gentleman from the not very agricultural district of Hammersmith. County magistrates who love power may sleep soundly in their beds; it will be long before their financial wisdom or folly is disturbed by financial boards or representative institutions in any shape. At no distant date,

the management of highways and parish roads will be practically transferred to the county magistracy: it is even possible that an Act of Parliament, already shadowed forth by the *Times*, may place game under charge of the rural police: other duties may be added—why not the collection of the assessed taxes, &c.? The entirely irresponsible county magistrates have so much to do, it would be well to give them more, and then there will be the more reason for making them responsible. Tenant farmers, at present, are too much in awe of their landlords to oppose them in public on any question. They murmur over their port wine in the afternoon, and protest loudly over their brandy and water in the evening, but sleep brings counsel, and the next morning they submit to the malt-tax, game-preserves, or county rates. It will take another generation to introduce representative institutions into agricultural districts. A Belgian commission, instructed to inquire into our system of county government, was surprised to find so few traces of the representative principle on which it is supposed that the English Government rests. The lord-lieutenant, the high sheriff, the magistrates who manage all the judicial and financial business, are all appointed by the Crown: the coroner alone is elected by the freeholders, and under the control of the magistrates. Until lately, this system was inevitable; the tenant-farmers were too accustomed to stay at home, and too uneducated to be trusted with county business. But in many counties they are, at the present day, the equals and superiors of the magistrates as men of business. They manage the poor-rate, a much more important charge than the county-rate; and, when their discontent has reached such a boiling point—it has long simmered—that they make county expenditure an election test, local representative institutions will quickly follow. After all, the majority of financial boards would still be county magistrates: a few obnoxious, incapable, extravagant individuals, would be sent to graze on their own freeholds, if any, and a few clever tenant-farmers would replace them—that would be all. We are not ruled by Acts of Parliament in this country half so much as by public opinion expressed in the newspapers. When farmers speak out in the newspapers, magistrates will, with the good sense that eminently distinguishes our aristocracy, give way, but not until then.

The Australian papers of March contain a sketch of a project for a new steam communication with Europe, which, if carried out, will do more to increase the population and capital of those colonies than anything that has been attempted since wool became an export, and gold-seeking an occupation. It is proposed to construct steam-ships of from 6000 to 8000 tons burthen, capable of carrying sufficient coals, without stopping for a supply, and of sufficient speed to complete the transit, by way of the Cape, in forty or forty-five days. The capital to be raised, under a colonial guarantee of £4 per cent., for a limited period, with a subsidy from the Government of Victoria of £4000 per trip. In return for these aids, the projectors propose to bring out 350 emigrants a month, at from £10 to £12 each—being £4 or £5 below the current rate; first-class passengers at about £70; second, at £35; and third, at £20. The freights of gold would be nearly all secured by so safe and swift a conveyance, because it would save many days interest. These are the calculations of the projectors, Messrs. Campbell and Burstall. The colonial guarantees and subsidies are pretty safe. Whether the ships can do what is required, must be asked of our shipbuilding engineers on the Thames and the Clyde. Of course, Mr. Scott Russell is ready; but people have not the faith in his assertions they once had.

Vine cultivation is making immense strides in Victoria, for grapes are selling there at 2d. per lb., while wines are purchased by the publicans at from 12s. to 13s. per gallon—an encouraging price, considering that, in a year of drought, the vineyards yielded from *four hundred to five hundred gallons* per acre; and, in the favourable year of 1861, the average of all the vineyards was 630 gallons per acre. The strength of the wines in the cellar of an experienced wine-maker in Melbourne was found to be two degrees above Spanish, and four or five above French wines, in the best seasons. Should the results of these reasonable expectations be realized, Australia may become independent of Europe for all wine and brandy, except the finest; but it is not likely that exportation will take place while the colonial demand is so large, and Hungary and Italy are at hand to fill the cellars of England and Northern Europe, if France and Germany should be unequal to the duty.

The Victorian Parliament, about two years ago, in its anxiety to be "at all in the ring," voted funds for a board of agriculture and an experimental farm. The first might have been of some use, if it had included one such man as our Arthur Young. As for experimental farms, they are absurdities only useful as sinecures for idle, farming men, and amusements for professors. The last-received *Melbourne Argus* thus describes the result of a very heavy expenditure:—

> The Board of Agriculture is still in a fidgety, spasmodic state of existence; either months too late in arriving at a decision, or determining not to do so, on any important question referred to it, or else doing something altogether useless, for the sake of keeping up an appearance of action. But, now that the experimental farm has been handed over to a manager without the least practical knowledge of any branch of this subject, although there were really good men among the applicants for the post, the last and only bond of connexion is broken, and the farmers generally do not care a straw whether the board lives or dies.

In the older colony of New South Wales, public works are pushed on with great vigour. Fifty pounds a mile have been voted for keeping roads in repair; and very large sums are being expended in improving the harbours, making breakwaters, quays, and piers—all, or nearly all, the rivers of that country being impeded by bars. Red tape seems to have extended its net even to democratic Australia; for we find that the works of the harbour of Wollongong were recently for several weeks at a standstill, in consequence of an insufficient supply of rails. "About one hundred men have been employed on the works; a much larger number would have been engaged had the requisite apparatus been obtainable. The want of this did not arise, we understand, from the actual scarcity of the material, as there was an abundance in the possession of the railway department; but there appeared to be technical difficulties attending the transfer of material from one department to another, and it was apprehended that objection would be captiously taken by some members of the Assembly to such an irregularity, although committed for the purpose of expediting the public works. The consequence was, that Mr. Moriarty has been obliged to obtain a supply of rails from Melbourne."

The Admiralty, under the guidance of the inaccessible Duke of Somerset, are treating Captain Coles in a very characteristic manner. First, they pooh poohed his invention; then they did their best to burke it; then, when the *Monitor* and *Merrimac* forced the pass, and made even the first lord hear, they proceeded to use his ideas, and spoil them. Captain Coles, not having the fear of the Lords of the Admiralty enough before his eyes to make him bear their mutilation of his bantling in silence, speaks through the *Times*, and then Lord C. Paget, having by his own insubordination gained his warm berth, snubs him, because, being on full pay, he dares to speak out; and twits him with desiring to design ships, "not being a shipbuilder." It would be worth while for some enterprising M.P. to inquire not only what was Sir W. Symonds, and Sir Baldwin Walker, but what is Admiral Robinson, who has lately been appointed to supervise the reconstruction of our iron navy? Does Captain Coles know as much or more than Admiral Robinson of iron and its uses in shipbuilding?

We are delighted to find that there is one subject on which we can agree with Edwin Chadwick, C.B.—the introduction of military drill and exercises into all schools, especially working boys schools. It is the one thing much needed amongst our stout and slouching clowns, and thin, narrow-chested town paupers. At Norwood, a few years ago, the peace members of a London union committee successfully objected to the introduction of the manual and broad-sword drill. But that nonsense has been since used up.

The French papers are giving some amusing sketches of England and the English, the most amusing being from such correspondents as that of the *Courrier de Dimanche*, who visits the country for the first time, is totally ignorant of its literature, speaks the language just enough to call a cab or order a bad dinner, lives in Leicester Square, and takes his notions of the country from what he sees out of a railway-carriage window or the top of an omnibus. There cannot be a question that London is a dark, gloomy, ill-built City, singularly deficient in architectural attractions, with frightful public statues, mean fountains, and a singular want of imposing public buildings. It is inhabited by people who go home or get into the country as soon as they can, and, except in the Hebrew and Irish quarters, are seldom found gossiping in the street outside the houses, in the continental and oriental fashion. As woollen clothes are comparatively cheap, wages higher, and provisions cheaper than in Paris, a London mechanic would

no more think of wearing a *blouse* than a smock-frock on Sundays and holidays; and, on working days, he wears the comfortable but unpicturesque tweed, or fustian, or corduroy. What is gained in comfort and health is lost in artistic effect; and the Frenchman speaks truly who says that out of doors, London, except in the parks, looks dull, as compared with Paris. The workmen of London are better clad, better fed, better housed, than those of Paris; they pay less for rent, clothes, meat, and fish; even their amusements are cheaper—cheap trains, cheap steamboats, cheap singing rooms; but they do not so well understand how to amuse themselves, for the simple reason that what amuses a Frenchman would often not interest an English workman at all. But the Frenchman who complains that London has drained the country of its wealth, intellect, and energy, only shows that he has not read the works of those of his countrymen who have travelled further than Leicester Square, Regent Street, and Hampton Court. "*Lavergne*"-*Barral*, De Tocqueville, Montalembert, tell a different story. They tell how every wealthy English and Scotch tradesman, manufacturer, lawyer, and doctor, aims at purchasing and improving an estate, and leaving London life to become a member of the county powers.

There is one subject on which the French writers cannot say too much—the abominable mismanagement of the International Exhibition. A month will scarcely get it into working order, and not even a month, unless a competent chief commissioner be found. We have never witnessed worse management, nor more discontent since we were in Paris at the last two International Exhibitions there. There, too, the rules in theory were excellent; in practice, as Mr. Henry Cole can tell, they broke down. Nothing less than a wholesale distribution of prize medals soothed the disgusted feelings of the British exhibitors. Red tape impeded work at every step at the first; and, at the second, the Agricultural Exhibition, the Emperor being absent, the whole machine nearly came to a dead lock. The authorities, secretaries or managers, when wanted had either not arrived, or were at luncheon; that is about mid-day dinner, or had departed for the day. Foreign jurors, foreign representatives of the press, received not the slightest attention; hospitality seemed unknown in an agricultural sense. A large party of English agriculturists, who dined together at Philippe's, compared notes, and found that not one had received an invitation of any kind in his capacity as a stranger, juror, exhibitor, or journalist. The regulations of the Exhibition were most annoying, and the tariff of the refreshments extravagant. But there was this difference between the French and English mismanagement—in Paris, no one was allowed to complain in print, and no Frenchman dared to grumble aloud. Complaints that found their way into English and Scotch newspapers were heard of in Paris as Oliver Twist's petition for more was heard by the Beadle Bumble. The French are wise in protesting abroad against that system of over-regulation at South Kensington which they must bear at home in silence, for thus they criticize their police Government by implication.

Circular to Gas Companies.

The objects in the International Exhibition that relate to the manufacture and distribution of gas are so incongruously arranged, that it requires much search in all parts of the building to find them out. Even those of the English exhibitors are dispersed in nine different classes, situated widely apart; and the articles contributed by foreigners are to be looked for in the divisions appropriated to each country. The foreign departments are, however, yet far from being completed; but, confining our views to the British goods alone, we have to look in various directions, to be able to indicate whereabouts they may be seen. Thus, for example, fire-bricks and retorts may be found in Class I., in the eastern *annexe*, and in Classes X. and X. B, in the south court; various kinds of gas-making apparatus are exhibited in Classes I., VII., X., X. B, and XXXI. B—Class VII. being in the western *annexe*, among the machinery in motion, and Class XXXI. B, in the south-eastern part of the building; gas-meters are exhibited in Classes X., XIII., and XXXI. B, one of which, XIII., is situated in the north gallery. There are gas-fittings in Classes VIII., X., XXXI. B, XXXI. C, and XXXIV., which extend from the south-east corner to the western *annexe;* and photometers are exhibited in Classes X., XIII., and XXXI. B.

The collection of gas-meters is probably the most complete and concentrated, for, with four exceptions, they are placed in Class XXXI. B, and occupy a small court in the south-east transept, between the east dome and the south-east tower. In that court, placed side by side, are to be seen specimens of the meters manufactured by Messrs. Alder, of Edinburgh (6277); Bischoff, Brown, and Co., London, Clegg's patent (6283); W. and B. Cowan, Edinburgh, Esson's and Kay's patents, and the ordinary wet and dry construction (6288); Croll, Rait, and Co., London (6289); H. A. Duckham, London (6294); T. Edge, London (6295); G. Glover and Co., London (6300); Thomas Glover, London (6301); Guest and Chrimes, Rotherham, Crosley and Goldsmith's patent (6304); W. Richards, London (6342); W. Sugg, London (6350); F. G. Underhay, London (6355); and West and Gregson, Oldham (6359). In several instances, the meters are made with glass fronts, to show the internal construction; and Mr. Richards exhibits, in his case, a most interesting collection of various descriptions of meters in several stages of their manufacture. In the same court, there is also exhibited, by Mr. J. Reid, of Edinburgh (6340), an apparatus which he calls a "gas-saturator," the object of which is to prevent the evaporation of water from wet meters. Messrs. Laidlaw and Sons, of Glasgow and Edinburgh, exhibit their meters in Class X. (2309); and, in the same class, Mr. George Glover has an additional stall (2291) for exhibiting his meters and a standard Exchequer gasholder; whilst, far off, at the extreme end of the north gallery, Mr. Sugg has a separate compartment allotted to him (2973) for the exhibition of his meters and other apparatus.

The display of chandeliers, gaseliers, lamps, burners, and other gas-fittings, is very extensive, and of a superior description. Most of the leading houses have contributed to this collection, which is placed in the gas-meter court, in the south-east transept, and in that portion of the south court appropriated to Birmingham. Of the London makers, Messrs. J. Defries and Son stand first in alphabetical order, and also in their magnificent display of chandeliers in richly-cut glass. Their large chandelier in the central division of the south court is one of the attractive features of the Exhibition. The main body of the chandelier is constructed of immense prisms, each 3 feet 6 inches long, forming a large prismatic dish; and there are pillars, and plumes, and coronets, and *bouquets* of crystal flowers, grouped together in profuse abundance, from the midst of which prismatic radiance there are to issue 168 lights. Messrs. Defries, indeed, seem determined to dazzle the eyes of the visitors; for, in addition to this magnificent chandelier, they display one of the prismatic mirrors, containing 1500 silvered prisms, that they have recently sent to add to the fascinations of the new palace of the Sultan on the Bosphorus. Proceeding in alphabetical order, Messrs. Geo. Forrest and Son (6298) exhibit a candelabrum and chandeliers; H. and J. Gardner (6299) have a large and handsome case, filled with similar objects in great variety; and chandeliers, gaseliers, lamps, and gas-burners, are contributed by W. Harrow and Son (6306), Hart and Son (6307), R. H. Hughes (6316), Hulett and Co. (6317), Johnston Brothers (6319), T. Lambert and Son (6320), S. Leoni (6322), and by B. Verity and Sons (6356). Of the foregoing, Messrs. Hulett and Co. make the largest display—a case containing specimens of the various articles manufactured by that eminent firm occupying the centre of the meter-court. Among the gaseliers, one made for a cathedral by Messrs. Johnston Brothers is most conspicuous for its size and decorations. Nor must we omit to notice the magnificent pair of colossal candelabra in crystal glass, contributed by Messrs. Osler, which occupy conspicuous places on each side of the British nave, and add materially to the ornamentation of that part of the building.

The Birmingham manufacturers exhibit in great force, and in a highly creditable style, many of their designs for chandeliers possessing great beauty and simplicity, whilst others shine forth with glittering brilliancy and elaborate workmanship. Those of Messrs. Messenger (6327), and of W. Winfield and Son (6257), are most conspicuous; and scarcely less deserving of notice are the manufactures of Cartwright, Sambridge, and Knight (6286), Gray, Bailey, and Bartlett (6302), J. Hardman and Co. (6305), J. Hill (6311), C. J. Philip (6335), Rennie and Adcock, who exhibit a massive electro-plated chandelier, intended for India (6341), and Wootton and Powell (6360). The Skidmore Art Manufactures Company, of Coventry, who occupy an extensive area in the south-east transept, exhibit numerous specimens of gaseliers of

superior taste and workmanship. Messrs. Hardman and Co. fill an entire court in the same transept with a magnificent display of mediæval metal-work, including gaseliers and chandeliers. There is a striking incongruity in associating one of the most important inventions of this century with the mediæval arts: but even the most monkish-minded of ecclesiastics cannot shut their eyes against the advantage of gas lighting: therefore, those manufacturers who endeavour to imitate the works of past ages are nevertheless compelled to adapt their designs to the introduction of the applications of this modern invention.

There are numerous articles connected with the manufacture and combustion of gas, and with the proposed substitutes for it, dispersed in various parts of the Exhibition. In Class X., Mr. Bower, of St. Neots (2240), Messrs. Porter and Co., of Lincoln (2332), and Messrs. J. Edmundson, of Dublin (2273), exhibit small apparatus for making gas, adapted for small towns, for churches, and for manufactories. In the same class, are Mr. J. V. Clarke's regulators (2257); the four-way valves for purifiers, of Messrs. Cockey and Son, of Frome (2261), the most perfect and the cheapest apparatus yet introduced for stopping the flow of gas or for altering its direction; and the valves of Messrs. C. Walker and Sons (2357). Specimens of other valves for gas, contributed by Mr. J. Beck (1796), and by Messrs. B. Donkin and Co. (1840), have found their way into Class VIII., among the machinery in motion, in the western *annexe*. In the same department is to be seen, in action, Mr. F. H. Holmes's magneto-electric machine applied to the production of the electric light, and introduced into a light-house lens. The light thus produced emits rays of dazzling splendour, but the large size of the wheel, the number of magnets applied to it, and the velocity of rotation, indicate the employment of a power which must be more costly in practice than the expense of a voltaic battery equal to produce the same effect. The carbon points are fitted with a self-adjusting apparatus which appeared to keep the light steady, for the short time that we saw it in operation. Mr. Shepard's magneto-electric machine, for producing light (1985), is also in the same department, but we did not see it in action. The apparatus for Mr. Prosser's lime-light (6338), is shown in the gas-meter court. The Hon. Major Fitzmaurice's apparatus for making oil and coal-gas, respecting the merits of which invention there was much question, is entered in the Catalogue number 2283, but we could not discover it, and, on inquiry, we were told that it is nowhere. Mr. W. Strode's sun-burners, with his ingenious valve for regulating the ventilation, are shown in Class XXXI. B (6349); where may also be seen specimens of Mr. Leoni's adamas burners (6322), which continue, by the satisfactory manner in which they wear, to justify our commendation of them when first introduced to public notice. In an open court in the eastern *annexe*, there has been erected a workable bed of six of Mr. G. Walcott's clay retorts (387), in which the ordinary plan of construction is reversed, the flues being made of hollow bricks, through which the heat passes, while spaces between the flues form the retorts in which the coal is distilled. Several beds have been erected on this plan, and they are, we believe, now in use at the West London Gas Works, for the supply of gas to the Great Western Railway terminus. In the same *annexe*, there is also a model of a setting of seven double clay retorts (283), exhibited by Mr. A. Potter, of Newcastle-on-Tyne.

Specimens of photometers, eudiometers, pressure-gauges, regulators, and of other apparatus for testing the illuminating power and for regulating the pressure of gas, will be found in Classes X., XIII., and XXXI. B. Mr. Sugg's cases (2973), in Class XIII., contain several of these instruments; and not far from them may be seen Mr. Young's electrodes for the electric light (2997).

British ironfounders maintain their admitted superiority in cast-iron pipes. Specimens contributed by Messrs. Cochrane and Co., of Dudley, are exhibited in Class I. (62), and Messrs. Edington and Co., of the Phœnix Works, Glasgow; Maclaren and Co., of the Eglington Foundry, Glasgow; and D. Y. Stewart and Co., also of Glasgow, exhibit fine castings of iron pipes.

Of fire-clay retorts and fire-bricks, there are many specimens, of which the following Stourbridge manufacturers contribute largely:—Hall and Co. (134), Harper and Moores (139), King Brothers (187), and Perrens and Harrison (273). Mr. Potter (283), and Messrs. G. H. Ramsay and Sons (291), of Newcastle, and Messrs. Gibb and Canning, Tamworth, exhibit clay retorts and fire-bricks in the same class; and in Class X. there are specimens of similar manufactures contributed by E. Brooke, Huddersfield (2241), J. Cliff and Son, Wortley, near Leeds (2259), J. Cowen and Co., Newcastle-on-Tyne (2265), Fishe Brothers and Co., Stourbridge (2281), J. Havie, Hurlford (2301), W. Ingham and Sons, Wortley, near Leeds (2302), A. Lucas and Sons, Gateshead (2312), W. Stephenson and Sons, Newcastle-on-Tyne (2344); and in Class X. B there is still another contributor of the same class of goods—E. B. Beaumont, of Barnsley (2371).

There are numerous specimens of gas-coals exhibited in the eastern *annexe*, and several sections of the mines from which they were extracted. A specimen-section of the deep cannel pits at Wigan, exhibited by Messrs. Case and Morris (55), will attract much attention, specimens being shown of the actual strata at different depths, and of the relative thickness of each. A very fine block of Wigan cannel, about 4 feet thick, is exhibited by Mr. A. Hewlett (151), for the Earl of Crawfurd and Balcarras; and another specimen, nearly equal to it, is contributed by Mr. J. Howie, of Kilmarnock (162). Among the chemical productions, shown in the same part of the building, there are many interesting specimens of the products of coal-tar, particularly of those beautiful dyes that are now so much admired. A magnificent crown, made of crystallized roseine, is exhibited among other products of coal-tar by Messrs. Simpson, Maule, and Nicholson, London (600). Of paraffin and paraffin candles, there are abundant specimens.

The foregoing catalogue *raisonné* will serve to guide our readers whereabouts to look for the various articles of British manufacture they may wish to examine. We can do little more than name the great number of objects which claim their attention; and, amidst the quantity dispersed in so many different parts of the building, it is probable that there are several which have escaped our notice. The collection exhibited is a very fair representation of the state of manufacture of gas apparatus in this country. Of foreign contributions in the same department of the manufacturing arts, we shall at present say nothing, for they are not at present fully displayed; and we must, therefore, reserve our notice of them to a further occasion.

The complaints against the feeble light of the street-lamps in the City to which the carburetting process is applied, have been considered since our last at meetings of the Commissioners of Sewers, and the matter has been referred to the General Purposes Committee. It appears to be generally admitted that the light given by many of the lamps to which that process is applied is much inferior to that of the 5-feet burners when the gas is not so treated: and, in several instances, the light has been so feeble that the lamps have been extinguished. The "Carburating Company" attribute the defective light to the insufficiency of the supply of gas, and assert that, in a large number of the lamps to which their process is applied, the Great Central Company supply much less than the 3 feet per hour contracted for. We have made inquiries on the subject, and find that the deficiency of gas complained of arises entirely from the obstruction to its passage through the naphthalizing apparatus. We understand that nearly one inch of pressure is lost in passing through the carburetting boxes, and that when they are removed there is an abundant supply. In several instances, we are informed, in which the light was very dim, on the removal of the boxes the flame rose to a height of twelve or fourteen inches. The accident we mentioned as having occurred from a defect in one of the tin naphtha cases fixed near the burners of the street-lamps was not a solitary instance. There have been three similar accidents; and the danger arising from the use of extremely volatile hydrocarbons was exemplified in a startling manner in a lecture delivered by Dr. Lyon Playfair, at the Royal Institution, on the 8th inst. In the course of his lecture on gas illumination, Professor Playfair was endeavouring to illustrate the light-giving power of hydrocarbons, and, for that purpose, he passed a quantity of pure hydrogen through a small glass vessel containing naphtha. The gas bubbled up through the fluid, and, when he thought sufficient had passed to expel the atmospheric air, he applied a light to the tube, when a violent explosion ensued. The glass vessel was shattered, and fragments of it were thrown in all directions, cutting the faces of several of the audience, and filling the lecture room with dense suffocating vapour, which drove a large portion of the company away. If that accident could happen in the application of naphtha by an experienced manipulator like Dr. Lyon Playfair, it is evident

that such highly inflammable material cannot safely be trusted in the hands of ordinary workmen, to be applied even to the street-lamps, without considerable danger.

We have received several letters referring to the observations in our last "Circular" respecting the improbability of the ignition of an explosive mixture of carburetted hydrogen and atmospheric air by the dull-red heat of a plumber's iron, or by sparks, and an important communication on the subject from Dr. Frankland will be found in another column. In this communication, which will be read with much interest, the question is thoroughly and experimentally investigated, and the igniting point of coal-gas under various circumstances is accurately determined. The result of this investigation bears out our assertions, though we were not prepared to find that the difference between the igniting points of light carburetted hydrogen of coal mines and of coal-gas is so great that, in the one case, sparks from steel may be safely struck, while they will explode a mixture of coal-gas and atmospheric air. Bischof, who is quoted as an authority by Dr. Frankland, confirms our opinion that carburetted hydrogen cannot be inflamed by burning tinder, even when strongly blown upon, and the fact may be readily proved by exposing lighted tinder to a jet of coal-gas at different distances. The chief point in dispute, as regards the explosion in Holborn, is, whether an explosive mixture of coal-gas with air can be ignited by "the dull red heat of a plumber's iron," or whether the accident was not caused by some inflammable particles being blown against the hot iron, which took fire and exploded the gas. The experiments of Dr. Frankland prove that it requires a higher temperature than that of a plumber's iron to ignite ordinary coal-gas, though it may be rendered sufficiently inflammable to be so ignited when mixed with a large proportion of bisulphide of carbon, or when mixed with atmospheric air in its passage through an open tube. That condition, however, does not apply in the case of the explosion in Holborn, for the main was closed at the end, and its horizontal position would not favour a separation of the constituent parts of the gas. The effect of olefiant gas in lowering the igniting point of carburetted hydrogen is a novel fact, and the inflammable nature of bisulphide of carbon vapour is also well deserving consideration. Dr. Frankland's communication possesses great practical as well as scientific value, and we are glad that our observations on the subject have been the means of procuring this important addition to the knowledge of the circumstances under which the ignition of coal-gas is possible.

The Select Committee of the House of Commons on the Parochial Assessments Bill held a sitting with closed doors on Thursday last, at which it has been intimated they decided upon amending the third clause of the Bill, so as to leave unaltered the law with respect to parochial assessments in England and Wales, as laid down in the 6th and 7th William IV., cap. 96. The Bill will probably be reported to the House in a few days; and, as the Select Committee have refused to hear witnesses, gas companies can now only hope to obtain any relief from the inequality of which they now complain by endeavouring to amend the Bill when under consideration in committee of the whole House.

Upon the motion of Lord Derby, and a representation by him of the damage done to property by the vapours emitted by some of the large chemical works in Lancashire, a Select Committee has been "appointed to inquire into the injury resulting from noxious vapours evolved in certain manufacturing processes, and into the state of the law relating thereto." As gas-works are clearly within the scope of this resolution, we shall watch with some anxiety the proceedings of this committee; but, as they sit and are hearing evidence with closed doors, the result of their deliberations can be only ascertained when they make their report.

Communicated Article.

ON THE IGNITING POINT OF COAL-GAS.

By Dr. E. Frankland, F.R.S.

The temperature at which coal-gas will ignite under ordinary, or extraordinary conditions, is a circumstance of considerable importance, both to manufacturers and consumers of gas; nevertheless, the recent explosion in Holborn, and the difference of opinion which evidently prevails, even amongst those who are intimately acquainted with the properties of coal-gas, prove that the subject has not hitherto received that attention which it obviously merits. Under these circumstances, the following experiments, and the conclusions drawn from them, although they are far from exhausting the subject, may not perhaps be altogether unacceptable as a contribution to this part of the history of coal-gas.

The heterogeneous mixture of gases and vapours, known as coal-gas, may for our present purpose be assumed to consist of:—

Olefiant gas and other luminiferous hydrocarbons.
Light carburetted hydrogen, or fire-damp.
Hydrogen.
Carbonic oxide.
Bisulphide of carbon.

Now, as these constituents can, to some extent, become separated from each other, under certain circumstances, it is desirable, at the outset of the inquiry, to examine separately their respective igniting points.

1. Olefiant gas, which may be taken also as the type of the remaining luminiferous hydrocarbons, could not be inflamed by a hot iron, unless the latter were heated until it appeared of a cherry-red colour in the daylight of a tolerably well-lighted room.

2. The igniting point of light carburetted hydrogen was carefully determined by Davy, to whose observations I have not a word to add. He says that, "light carburetted hydrogen can be inflamed by *white hot sparkling iron*, but not by iron at a red heat; it is, therefore, much less inflammable than hydrogen or carbonic oxide, and less so than olefiant gas." Bischof says that it cannot be inflamed by burning tinder, even though the tinder be strongly blown upon.

3. Hydrogen inflamed at a lower temperature than olefiant gas, but it could not be ignited by a rod of iron, unless the latter were heated to a temperature considerably beyond visible redness in a tolerably well-lighted room.

4. Carbonic oxide inflamed at a temperature somewhat greater than that at which hydrogen ignited, but lower than that necessary for the inflammation of olefiant gas.

5. Bisulphide of carbon vapour ignited at 300° Fahr.

In some experiments recently made in connexion with the gas explosion in Wood Street, I had occasion to observe that when coal-gas is allowed to mix with air contained in a space, partly enclosed, but still communicating freely with the atmosphere, such as the open gas-main in Holborn, for instance, there occurred an approximate separation of the lighter from the heavier constituents of the gas; thus samples of the explosive mixture taken from such a space were found on analysis to contain olefiant gas, luminiferous hydrocarbons, carbonic oxide, and bisulphide of carbon, with but a small per centage of light carburetted hydrogen, and mere traces of hydrogen, although the two latter gases constitute, as is well known, the chief bulk of coal-gas. These gases must, therefore, have rapidly made their way out of the partially-enclosed space into the atmosphere. This behaviour of the different constituents of coal-gas, when the latter is slowly admitted into one end of an open main containing atmospheric air, may not inaptly be compared to that of a number of birds, of different powers of flight, entering at one end of the pipe, and making the best of their way towards the opposite extremity. At every moment from the entrance of the birds, the per centage of those of swift flight would diminish near the entrance-end of the pipe, whilst that of the birds of slower velocity would obviously increase in the same ratio.

The Master of the Mint has proved that the rapidity with which gases diffuse into each other, or into a vacuum, is inversely proportional to the square roots of their specific gravities; and, although there are some circumstances in the case of the open gas-main, or partially-enclosed space, which would somewhat interfere with this ratio, yet, for all practical purposes, Mr. Graham's law may be assumed to express correctly the different velocities with which the constituents of coal-gas would hasten to escape from the space in question.

These velocities of diffusion are as follow:—

Bisulphide of carbon	1
Olefiant gas	1·66
Carbonic oxide	1·66
Light carburetted hydrogen . .	2·19
Hydrogen	6·23

All other luminiferous hydrocarbons existing in coal-gas must have a diffusion velocity lower than that of olefiant gas.

Thus the effect of diffusion of coal-gas in an open horizontal pipe, or other similar partially-enclosed space, would be to form an explosive mixture, containing chiefly hydrogen as the combustible gas, at or near the open extremity of the pipe; whilst the explosive mixture, formed near the end of the pipe where the gas entered, would contain chiefly carbonic oxide, olefiant gas, and bisulphide of carbon.

It is obvious, from experiment No. 3, that the explosive mixture, formed near the mouth of the tube, would ignite at a somewhat lower temperature than that required for the ignition of an explosive mixture containing all the constituents of coal-gas. Still, even this more inflammable mixture could not be ignited below a red heat distinctly visible in the daylight of a room. It might, however, be expected that the explosive mixture, formed at the opposite extremity of the tube, would be capable of ignition at a still lower temperature, owing to the continued increase in the proportion of the highly inflammable but sluggish bisulphide of carbon, which could, doubtless, under favourable circumstances, increase to at least ten times the amount originally contained in the coal-

gas. In order to ascertain the effect of the presence of a considerable per centage of bisulphide of carbon vapour upon the inflammability of the constituents of coal-gas, and especially of carbonic oxide and olefiant gas, the following experiments were made.

6. Carbonic oxide was mixed with about 3 per cent. of the vapour of bisulphide of carbon, and was then allowed to issue from a jet into the air. The jet of gas readily ignited on the approach of a glass tube containing oil heated to 410° Fahr., the igniting point of the gas being probably not higher than 350° Fahr.

7. Hydrogen, containing the same amount of bisulphide of carbon vapour, ignited by contact with a tube containing oil at 420° Fahr.

Here, then, was a phenomenon which would seem to indicate the alarming possibility of the ignition, at a comparatively very moderate heat, of explosive mixtures of coal-gas and air; fortunately, the next experiments entirely allay any apprehensions on this score.

8. Olefiant gas, impregnated with 3 per cent. of the vapour of bisulphide of carbon, did not inflame at a perceptibly lower temperature than when free from the admixture of the sulphur compound.

9. To the highly-inflammable mixture of carbonic oxide and vapour of bisulphide of carbon, used in experiment No. 6, a minute trace (not 0·1 per cent.) of olefiant gas was added; instantly, the igniting point of the mixture was raised to that of pure carbonic oxide.

10. A similar experiment with the hydrogen mixture (No. 7), gave a corresponding result.

Thus, the extraordinary inflammability which is imparted to carbonic oxide and hydrogen by the vapour of bisulphide of carbon, is entirely removed by mere traces of olefiant gas; and it is probable that the other luminiferous hydrocarbons contained in coal-gas would produce the same effect. In order to complete this part of the inquiry, it now only remained to extend these experiments to coal-gas itself.

11. Coal-gas could not, even under the most favourable circumstances, be ignited at a temperature perceptibly below that described in experiment No. 4, as necessary for the inflammation of carbonic oxide.

12. When coal-gas was mixed with 3 per cent. of bisulphide of carbon vapour, its igniting point was not lowered in the slightest degree.

Having thus proved that any amount of diffusion can have but a very slight effect upon the inflammability of explosive mixtures of coal-gas and air, the following experiments were made, to decide the disputed point, whether coal-gas can be inflamed by sparks:—

13. Hydrogen was readily inflamed by sparks struck from flint and steel.

14. Carbonic oxide was also readily ignited in a similar way.

15. The mixture of coal-gas and air, issuing from a wire-gauze burner, was repeatedly, and easily, inflamed by the sparks struck from flint and steel.

These results are quite in conformity with the experience of gas-engineers and managers, several letters from whom are now before me, describing the ignition of gas from the sparks elicited by the contact of a workman's pickaxe with stones, the chipping of a main, &c. The notion that coal-gas will not inflame under these circumstances has, doubtless, arisen from the impossibility of so igniting the gas of coal-mines; but the combustible gas existing in British coal-mines has been proved, by very numerous analyses to be light carburetted hydrogen only—no trace of hydrogen, carbonic oxide, or olefiant gas being ever present in it. Now, the igniting point of light carburetted hydrogen, as has already been explained, is very much higher than that of the other combustible gases present in coal-gas, and hence, whilst the mine may be safely lighted by the "steel mill," the use of such an instrument in an explosive mixture of coal-gas, would infallibly cause ignition. A word of warning as to the use of the safety-lamp in gas-works may perhaps not be here out of place. Even in the difficultly inflammable fire-damp mixture of coal-mines, the Davy lamp was known, by its inventor, to be unsafe in certain conditions,—as when placed in a strong draught or rapidly swung to and fro. Any degree of insecurity thus attaching to the safety-lamp in mines is increased tenfold when it is used in explosive mixtures of coal-gas, and hence it is highly desirable that the gauze of such lamps should be finer than that used in the miner's lamp, and also that the workmen should be stringently prohibited from placing the lamps in a draught of explosive gas, or swinging them to and fro, since the neglect of these precautions may easily cause disastrous explosions.

In conclusion, the results arrived at may be thus shortly summed up:—

1. Coal-gas cannot, even under the most favourable circumstances, be inflamed at a temperature below that necessary to render iron very perceptibly red hot by daylight in a well-lighted room. But this temperature is considerably below a red heat visible in the open air on a dull day.

2. This high igniting point of coal-gas, under all circumstances, is due in a great measure to the presence of olefiant gas and luminiferous hydrocarbons.

3. The igniting point of explosive mixtures of the gas of coal-mines is far higher than that of similar mixtures of coal-gas; consequently, degrees of heat, which are perfectly safe in coal-mines, may ignite coal-gas; hence, also, the safety-lamp is much less safe in coal-gas than in fire-damp.

4. Explosive mixtures of coal-gas and air may be inflamed by sparks struck from metal or stone. Thus an explosion may arise from the blow of the tool of a workman against iron or stone, from the tramp of a horse upon pavement, &c.

5. Explosive mixtures of coal-gas may also be ignited by a body of a comparatively low temperature, through the medium of a second body, whose igniting point is lower than that of coal-gas. Thus sulphur, or substances containing sulphur, may be inflamed far below visible redness; and the contact of iron below a red heat with very inflammable substances, such as cotton waste, may give rise to flame, which will then, of course, ignite the gaseous mixture.

Correspondence.

REMARKS ON CLAY RETORTS.

SIR,—As your valuable JOURNAL is the true reflex of all opinions relative to the manufacture of gas, and, as a maximum of information is far better than a minimum, I must beg you to accept the desire to give such as an apology for troubling you with a few remarks relative to the setting and working of clay retorts; and in making them I shall confine myself to my own practical observation. What we have to determine is, which is the best form of clay retort to use?—as the iron one may be classed amongst the things of the past—and I am of opinion the best retort is the small D-shape, made all in one piece. I can get the best practical results from that shape. The gas is of better quality than when made in either the round or oval shapes, the distillation being more equal. Further, they are better seated in the ovens, and offer more regular surfaces to the action of the fire, and are set chiefly with common fire-bricks; and they will last as long as any other known shape when subject to the same amount of heat.

As to the strength required in a retort, the question may be disposed of thus: if it is made of the best fire-clay, the strength necessary is what may be required to bear a pressure of four to six inches of water. I am now speaking of using retorts without an exhauster, as I do not use one, and have never found one necessary. Although the idea is prevalent that clay retorts cannot be profitably employed without one, my daily practice convinces me that I am right, because I can get as much gas per ton of coals, of as good quality without an exhauster, as where one is used. To illustrate my theory, I may say that I produce daily, from an 8 ft. 6 in. D-retort, 15 in. by 13 in., 5000 feet of gas. I do not think more can be produced with an exhauster; and I am quite sure I could not produce that amount from round or oval retorts of the same capacity. I think it is a mistake to put more than five retorts in an oven, as you often sacrifice utility to quantity. For example, you must either have your bottom retorts very low, or your top ones very high—in either of which cases they are very awkward to work—or you must increase your width, which is like robbing Peter to pay Paul. The fuel account, I believe, will be the same, whether you have ten retorts in one oven or in two.

To the large-oven retorts I think there are several objections; one is, their being made in pieces, which causes them to depend entirely upon external supports that are constantly burning away; another is, having so many joints, each of which is a receptacle for carbon, the removal of which is a great difficulty, making the oven excessively leaky, as all who have worked them will confirm, saying nothing for the quality of the gas made in a large oven. Suppose one to take a charge of 10 or 15 cwt. of coal, how long will it take a stoker to draw and charge it, and how much heat and gas are lost during the operation? In setting clay retorts, the first thing to be considered is to get a firm bed for your retorts to rest upon, for upon that, in a great measure, the success or failure of the retorts rests; after that, put no more brickwork than is absolutely required to keep them in position. Care should also be taken not to cause draughts by flues more to one part of the retort than another. The flues over the top of the oven are, I think, not required, as the centre of the arch is generally hot enough; and, if it is not, it will get but little assistance from the use of such flues.

JOHN KEELING.

Reading Gas-Works, May 15, 1862.

MAIN-LAYING.

SIR,—The accident in Holborn, on the 16th of April, ought not to be forgotten. It should make main-layers more careful, and those who have the management of the work more vigilant. Such serious accidents are not numerous; the wonder is, they are not more so. The men employed at such jobs must not be expected to know the dangers to which they are exposed, and, by their ignorance or carelessness, to which they expose others. Careful attention to what would be supposed were well-known conditions, is all that is necessary. There are circumstances which insure complete safety; there are others which are attended by liability to danger. Instructions in such matters are seldom thought about. A few

cautions are passed carelessly from man to man, but without any explanations; and the habitual forgetfulness, and sometimes recklessness, of workmen, are almost always the causes of what are commonly, but improperly, called accidents.

A few months ago, an explosion, very similar to that in Holborn, occurred in the following manner:—An escape at the bladder, into newly-laid 5-inch mains, was ignited by a spark struck off by a workman's tool. An explosion ensued, but, instead of bursting the main, the plug was driven out. It struck a man who was at work in the trench, about 20 yards off, and broke his leg. The man was removed to the hospital, and died there.

A bladder for small mains, and a vulcanized india-rubber bag for large ones, if properly fitted and carefully watched, will effectually keep back the gas. But, whether a bladder or a bag be used, it should be frequently examined, and the stopcock protected from wilful or accidental disturbance; whilst it must be easily accessible to the person to whose care it is intrusted.

After being passed into the main, the bag (or bladder) is blown up with air from a man's lungs. On cooling, this air occupies less space; the bag partially collapses, and gas escapes. Hence the necessity for filling the bag again and again—not violently, or it will burst, but with sufficient force to make it an effectual (elastic) plug. When the air in the bag has acquired the same temperature as the gas in the main, if it be perfectly tight, all will go on well. Let not this be too surely reckoned upon. There is no certainty about its fitting the main accurately. There may be a wrinkle or a small hole in the bag, or a little deposit in the main; something to cause leakage, and which, if unnoticed or neglected, may occasion inconvenience or mischief. Then, again, it should be remembered, there is risk from other causes; such as, changes of temperature as the day advances, the heat of the sun upon the exposed main, or the vibrations of the ground by the passing of carriages. An increase of temperature is almost sure to burst the bag. I have witnessed it, in a 12-inch main, in ten minutes after the sun has broken through clouds. Still, the sudden bursting of the bag is not a hundredth-part so dangerous as continual and unobserved leakage. The loud report, and sudden rush of gas, give their unmistakeable warnings, and can be soon set right. The slow leakage which, mixing with air, forms an explosive mixture, is most to be guarded against. This can only be done by frequent examinations of the bag. In every case, there should be two or more spare bags close at hand. Another precaution deserves consideration. A stopper, made of 1½ or 2-inch deal, according to the size of the main, and luted in with clay, is preferable to a plug driven hard into the end of the main. In the Holborn case, the force of the explosive mixture was sufficient to burst the main, which it would not have done if the plug had been displaced. In the case I have mentioned, the plug was driven out, and the main was uninjured.

More might be said—especially on that part of the subject least of all understood. I mean the temperature required to ignite explosive mixtures. A spark, not visible in daylight, and which will have no effect upon coal-gas, will readily ignite a mixture of gas and air.

May 16.

* * * *

IGNITION OF GAS.

SIR,—As much discussion has arisen from your observations respecting the non-ignition of gas by sparks, I have made some experiments on the subject, which confirm your opinion that ordinary coal-gas cannot be inflamed by the sparks of combustible substances, nor even by hot iron, until it is nearly of a white heat. In the first place, I twisted some paper to form a kind of torch, and, when in full blaze, I extinguished it, and applied the remaining abundant supply of sparks to a current of gas from a fish-tail jet, at different distances, but without igniting the gas. I then blew on the sparks, to increase their ignition, but they did not set fire to the gas until blown into a flame. I afterwards heated a large poker in a hot coke fire, and, on applying it to the jet when nearly white hot, it set fire to the gas; but it quickly failed to do so, though of a glowing red heat. Some time after the heated iron had ceased to ignite the gas, I threw on to it some of the dust deposited on furniture, when the gas instantly ignited, in the manner you assumed was the case in the gas explosion in Holborn.

As these experiments, though very simple, seem to settle the question, I hope you may consider them worthy of being noticed in your JOURNAL.

May 14. C. B. F.

Review.

BEARDMORE'S "MANUAL OF HYDROLOGY."*

Under this title, Mr. Beardmore has published a third edition of the valuable set of tables which originally appeared in 1850; and it may at once be stated that the number of editions, and the gradual development the work has undergone during the interval between its original publication and the present reissue, are in themselves the most convincing proof of the importance of the want it was designed to meet, as well as of the skill and conscientious ability with which that want has been supplied. In its first form, Mr. Beardmore's "Practical Tables to Facilitate Hydraulic and other Calculations" appeared as a pamphlet of 60 pages; the edition of 1852 presented tables increased to 92 pages, and it was accompanied by an introductory essay on their use, extending to about 115 pages; and, in the third edition, Mr. Beardmore has still further extended his materials, until they occupy a thick volume of 384 pages, accompanied by numerous plates. Nothing but the success of the work could have carried its author through the labour and study it must have cost him; and most sincerely do we wish that he may find in the results of its publication the reward of his efforts to serve the cause of the profession he understands so well, and has so assiduously cultivated. English engineers are often reproached on account of their indisposition to communicate to others the result of their investigations and of their experience—with considerable justice it must also be said. On this score alone, we should feel the more deeply obliged to Mr. Beardmore for his contribution to the stock of professional literature; but the nature of his work is such as to increase the obligation, for its merits are of the highest description. Perhaps, the best mode of proving this opinion, and of conveying a proper estimation of the "Manual of Hydrology," would be to analyze its contents succinctly; this we will endeavour to do in the following lines, suggesting freely, by the way, whatever may seem to us desirable in any future editions.

The tables for facilitating calculations precede the notes upon hydrology in the third edition of Mr. Beardmore's work, instead of following them, as in the second edition; and it really strikes us that this improvement in the distribution of his materials might also have induced Mr. Beardmore to have separated them in a more decided manner. We mean, that it appears to us that it would have, perhaps, been more convenient to the bulk of the profession if the useful practical tables had been published in a small portable form, as in the original edition, whilst the hydrological notes were presented in a separate volume. In none of the handbooks, or engineers pocket-books or companions can be found a series of tables of equal value to those contained in Mr. Beardmore's work; and the former are all exposed to the objection of being too cumbrous for daily use, as much as is the "Manual of Hydrology" in its present form. But, passing over this trifling objection, the tables now given for calculating the discharge of water over weirs, by means of arterial drains, culverts, pipes, whether under pressure or flowing merely in consequence of the inclination of the open channel; those connected with the friction of bends, bridges, pipes, &c., may be stated to be not only more copious than those contained in the previous editions, but they have been revised so as to allow them to incorporate the results of the most recent observations of the English engineers. It is to be regretted, however, that Mr. Beardmore should not have referred also to the researches of our French neighbours in this respect, because, in his remarks on the use of Tables 8 a and 8 b, he states that he had adopted Dubuat's principle, "that the different materials of which the perimeter of a pipe may be composed do not sensibly affect the intensity of the resistance." The researches of Dupuit—to be met with in his "*Traité de la Conduite et la Distribution des Eaux*," Paris, 4to., 1854—show that the nature of the pipe has, nevertheless, an appreciable influence upon its rate of delivery, but, fortunately, in practice, the results of this disturbing cause are so small that they may safely be neglected; still, it must be a subject of regret that the fact of Dubuat's principle having been questioned, should not have been referred to.

Mr. Beardmore has wisely incorporated in his tables Mr. Pole's investigation of the discharge of aëriform fluids through pipes, and has thus rendered a service to gas engineers; but, valuable though the Table No. 7 may be, there still remains much to be done for the preparation of a thoroughly practical set of tables for this branch of the profession. It behoves gas engineers to supply these deficiencies, and they could not do better than communicate the results of their experience to Mr. Beardmore, in order to enable him to put them into useful form. The questions connected with the flow of gas in street-mains, as affected by friction, draught, difference of level, and difference of temperature, have not yet been made the subject of investigation; and, in fact, the whole of our knowledge, on these important questions of detail, is of the most empirical and unsatisfactory nature. Mr. Beardmore has only given the table for calculating the discharge of aëriform fluids through pipes of uniform diameter, receiving the fluid under uniform pressure, and discharging through its end—conditions which rarely occur in practice. Mr. Beardmore's new Table, No. 11, furnishes also a valuable addition to the previous series, and is, at the same time, likely to be of especial service to engineers who employ the more subtle fluids. Are we hypercritical in suggesting that it might be desirable to place it in immediate connexion with Table No. 7, as the subjects are, to a great extent, cognate? The other tables, of flood discharges, weight and strength of pipes, water supply, useful weights and measures, strength of beams, resistances of materials, areas, circumferences, roots, powers, logarithms, &c., are mainly those of the former editions, improved, and greatly extended, by the introduction of many new minor tables, as well as by working out some of the older ones to a higher degree. It is precisely on this score that Mr. Beardmore has merited so well of the profession; and the care, skill, and perseverance he has thus exhibited are beyond praise.

We observe, by the way, that, in Table No. 32 a, Mr. Beardmore has followed the authority of Smeaton, and has given the force of hurricanes at 49 feet per square foot; but it may be important to observe that instances have been recorded in which the force of such storms has, in flat, level countries, like Holland, attained 64 feet per foot superficial. In calculations with respect to stability of lofty buildings, it is, therefore, necessary to reckon upon the latter element of overthrow; and, indeed, to regard it as a minimum. Another criticism we would venture, also, to make, is to the effect that it would be desirable, in any reprint of this invaluable work, to explain a little more fully the application of the formulæ. Thus, in Table 26, it is stated that, "the multipliers for the transverse strength give the breaking weights for rectangular beams fixed at one end, and loaded at the other; thus $\frac{\text{Tab. No.} \times b \times d^2}{\text{length}} =$ breaking weight in pounds;" but there is nothing to show in what terms the breadth, depth, and length are to be expressed—an omission the more to

* "Manual of Hydrology; with Hydraulic and other Tables." By Nathaniel Beardmore. 8vo. London: Waterlow, 1862.

be regretted, because Tredgold's tables were drawn up from formulæ in which the first two were expressed in inches, and the last in feet. Scientific men, of course, would not experience any difficulty in this instance; but the usefulness of the work will be diminished in the hands of the mere practitioners of the building arts. It is singular, too, that Mr. Beardmore does not give the respective powers of the Dantzic or of the Canadian *firs*, although they are, perhaps, more used than any other of the woods—in ordinary constructions, at least. The tide tables, in this first division, in their latest form, merit something more than a passing allusion; and, indeed, the whole of the part of the book devoted to marine engineering is worthy of the praise it has already so justly received from the technical and scientific world.

To our mind, the second division of Mr. Beardmore's last edition of his "Manual" constitutes the most interesting portion of the work, and it supplies some valuable, precise data on a subject which hitherto has been only treated in a general manner by English writers on physical geography. In Dr. Robinson's "Principles of Mechanical Philosophy," there is, no doubt, to be found an able chapter on rivers; and such continental authors as Frisi, Fabre, De Prony, d'Aubuisson, Desfontaines, &c., have published elaborate studies upon the rivers they were especially employed upon; but we are not aware of the existence of any book in which so much and such varied information, with respect to the practical observations on the flow of surface and of underground waters, is to be found, as in Mr. Beardmore's new volume. This information must be of the more importance, on account of the increasing commercial value of water privileges, and of the extension of works for draining lands, for collecting the rain-flow of mountainous districts, and for disposing of the subterranean waters of large towns. A table might, perhaps, have been added, for the purpose of showing the actual results of the piped gathering-grounds of such places as Rugby, Sandgate, &c.; for, in spite of the marked commercial failures of both these last-named operations, the principle on which they are founded is still put forward authoritatively by a certain school of sanitary reformers; and it has actually been suggested, within a very recent period, for the water supply of Antwerp. What Mr. Beardmore has given is, however, of the greatest value; and it will furnish the elements for future development (let us hope) under his own direction. Surely, at the present day, the engineers who are engaged in such countries as the Punjaub, Burmah, South Africa, Australia, in our North American colonies, and in the tropical regions of South America, must be in a position to add to the records Mr. Beardmore has been able to collect upon the English and Irish rivers, the Rhône, Saône, Loire, Rhine, Po, Nile, Ganges, &c.; and the climatological conditions of all those regions present characteristic differences such as would throw great light upon the hitherto unsolved problems of hydrology. Ellet's work, "On the Mississippi and Ohio Rivers," and the observations of the engineers attached to the irrigation departments of the Bengal and Madras provinces, contain some partial information of the description required; but Mr. Beardmore's book has the merit of suggesting the manner in which future observations should be made, equally with that of using well those which were at his command. A good treatise upon rivers, and upon the various phenomena connected with the marvellous circulation of waters upon the face of the globe, has still to be written. No man is more capable of discharging the task than Mr. Beardmore himself.

The third division, devoted to the record of the observations, and the tables connected with tides, estuaries, and tidal rivers, contains a great amount of matter of the utmost importance to the hydraulic engineer. We are not, indeed, aware of the existence of any work in which so much information, so many practical observations on the various phenomena connected with marine engineering, are to be met with; but even the extent of Mr. Beardmore's reading on the subject, and the copious nature of the materials he has brought together, only serve to render more irksome the conviction every sincere student must feel, that "all we know is that we know nothing." The results of the laws of the translation of the tidal waves upon the British Channel are, for instance, mentioned in general terms at page 218 of the manual; and the tidal phenomena of the Seine are also referred to at page 207. Yet, there are other phenomena than those Mr. Beardmore has noticed, which require to be taken into account, and which it is to be regretted that he has not brought under his own acute investigation. We allude to the effect of projecting headlands, and of deep bays, in modifying the rate and manner of the advance of the tidal wave; and of the nature of the shores upon the production and advance of alluvial matters. The mischievous effect upon Dover Bay produced by the new Admiralty Pier, and the gradual shoaling up of the estuary of the Stour and Orwell, which any competent engineer ought to have foreseen and guarded against, may be cited as proofs of the necessity for putting in order the dispersed information we actually possess on this vital question of the advance of littoral alluvions. Again, Mr. Beardmore does not seem to be really acquainted with—if we may judge from his book—the persevering efforts made by the French engineers to improve the tidal portion of the Seine; and his remarks upon that river are extracted simply from a second class paper in one of the technical French reviews. A reference to the works of Lamblardie, Frissart, Babinet, Bouniceau, &c., to the reports of the Chamber of Commerce of Rouen, of the *Ingénieurs de la Seine Inférieure*, to the Minister of Public Works, and even to some papers by, MM. Marchal and Belgrand, on the hydrology of the Seine, inserted in the *Annales des Ponts* and *Chaussées*, would show that "there are more things in heaven and earth than are dreamt of in the philosophy" of the majority of our rulers, and of their agents, whose documents Mr. Beardmore has so carefully brought together. M. Marchal's "*Mémoire sur les Alluvions à l'Embouchure des Fleuves dans la Manche*," inserted in the *Annales* for March and April, 1854, is, indeed, one which merits more attention than it has received from hydraulic engineers, either here or abroad. In this JOURNAL, it has often been referred to, and its bearings upon the question of the position of the outflow for the metropolitan sewage dwelt upon; and we have also called attention to the reports of the Dutch engineers upon the state, past and present, of the *embouchures* of the Meuse and Rhine. We cannot, therefore, but feel regret that Mr. Beardmore should not have included the subjects of investigation they suggest in his otherwise extensive range of inquiry; and we would earnestly beg him in any future edition of his work to repair what we consider to be an omission. Truly "art is long, and life is short," and it is demanding too much from the author of a manual of hydrology to expect that he should exhaust the whole range of that complicated science; but Mr. Beardmore has done so much that naturally we look to him for more, and are almost surprised to find any omissions in his works.

The fourth division, which treats of rainfall and evaporation, worthily closes the series of records connected with the science of hydrology, and enables English engineers especially to substitute definite figures for the empirical rules hitherto adopted in the calculations wherein those phenomena were concerned. The patient skill required for grouping together the numerous tables Mr. Beardmore has incorporated in this part of the work, can only be appreciated by those who had previously experienced the inconvenience of its want, and who had endeavoured to collect such tables for their own use. Emphatically, the service rendered in this matter, and, indeed, in the publication of the whole series of tables, has been of the highest order; and Mr. Beardmore, we again repeat, has deserved the gratitude and esteem of the whole engineering profession, for so unreservedly placing his learning and experience at their disposal.

The plates which accompany the new edition, and the general style and manner of its production, are highly creditable; with the exception, perhaps, of a few mistakes in printing, which might have been avoided by a more careful reading, by an indifferent party. All who have had experience in the press, know how easy it is for an author to read the proofs of his book as he wishes them to appear; and it is on that account that we would recommend Mr. Beardmore to intrust the proofs of any subsequent edition to the revision of a stranger. We count upon the necessity for such subsequent edition, and, indeed, are so convinced that it will soon be called for, that we have even gone out of our way to suggest the developments it might be made to embrace. In its present form, the book is invaluable, and most earnestly do we recommend to the attention of our readers Mr. Beardmore's "Manual of Hydrology." May it be the precursor of other manuals of the various branches of engineering science! The French boast of Geniey's, Consinery's, Claudel's, Morin's tables; we can only cite M'Neil's, Neville's, and now Beardmore's—but none of these are of the same comprehensive character as those of Claudel. There is no one so competent to supply our wants in this respect as Mr. Beardmore, and he has given us the first instalment in the noble work we have thus noticed.

Register of New Patents.

2344.—JOHN GRAHAM, of 2, Anne Street, Devonport Street, Commercial Road East, London, pattern-maker, for "*An improved double-acting force or lift-pump for ships, fire-engines, and other purposes.*" Patent dated Sept. 20, 1861.

This invention consists of a double-acting force or lift-pump, which is constructed with two chambers, and with two buckets or plungers working in each chamber. The rod of the bottom bucket or plunger in each chamber works through an orifice in the upper bucket or plunger made water-tight, by means of a moveable brass packing, so as to allow the rod to work in it without a parallel motion. Motion is given to the buckets in each chamber, so that when the one is ascending, the other is descending, the upper bucket moving up and down in the upper end of the chamber, and the lower bucket up and down in the lower end of the chamber, meeting, or nearly so, in the middle of the chamber. At the side of each chamber or connected with it, an auxiliary chamber or suction-pipe is made, with a suction-valve at the bottom of it for admitting water during the ascent of the upper bucket, the water being admitted through the suction-valve at the bottom of the working chamber during the ascent of the lower bucket; and, when one of the valves for admitting water is open, the other is closed.

The water raised by the lower bucket of each pump is forced through an opening furnished with a valve into a reservoir, placed between the working chambers or in any convenient position, and the water raised by each of the upper buckets passes over the top of the working chamber into the same reservoir. The machine must be constructed, or so placed, that the suction-valves shall be in contact with the water to be lifted. It is preferred to give motion to the buckets and their rods in each chamber by means of an arrangement of two levers or beams, the motion being transmitted from the first to the second lever or beam by means of a tumbling-lever working on a joint or fulcrum-pin fixed on the framing, or in any convenient manner. The tumbling-lever has two arms, and at the end of each arm is placed a stud-pin, with a friction-roller mounted upon the stud-pin, and moving backwards and forwards in a segment of a circle. Motion is given to the rocking-lever by means of an arm fixed to the under side of the first lever or beam, the end of the arm being furnished with a stud-pin, carrying a friction-roller, which roller works in a vertical slot on the tumbling-lever, so that when the first lever or beam has motion given to it in one direction, the arms of the tumbling-lever are moved in the opposite direction.

The friction-rollers, at the ends of the arms of the tumbling-lever, work in slots in the second lever or beam, so as to cause the second lever or beam to move in the same direction as the arms of the tumbling-lever, and in a direction the reverse to that of the first lever or beam; and thus upon motion being given alternately to the first lever or beam first in one direction and then in another, the second lever, or beam will, in every case, have motion given to it in the reverse direction. The rods of one of the upper buckets is to be connected with one end of one of the levers or beams, and the rod of the other upper bucket is to be connected with the opposite end of the same lever or beam, so that when one bucket is caused to ascend the other will be caused to descend. The lower buckets are to be connected in like manner with the ends of the other lever or beam, so that when one of them is raised the other will be lowered, and the upper and lower buckets of each chamber, when in motion, will move in opposite directions.

2350.—Brooke Smith, of the firm of Martineau and Smith, of Birmingham, Warwick, manufacturers, for "*Improvements in taps and cocks.*" Provisional protection only obtained. Dated Sept. 20, 1861.

This invention consists of arrangements of parts hereinafter explained of such taps and cocks as act by the raising and lowering of a valve by means of a screw, by which arrangements the stuffing-box through which the spindle of the screw is ordinarily made to pass is dispensed with, and leakage round the said spindle prevented. The lower end of the spindle is made conical, the smallest diameter of the conical part being uppermost; and on the wider side of the cover of the tap is a conical collar, the smallest diameter of the said collar being downwards. The cylindrical part of the spindle works freely in the said collar. A strong tube or hollow cylinder of vulcanized india-rubber, having an inner diameter somewhat larger than the diameter of the cylindrical part of the spindle, is placed upon the said spindle before it is passed through the cover of the tap; and, when the spindle is fixed in its place in the tap by the screwing down of the cover, the lower end of the tube of vulcanized india-rubber fits on about the middle of the cone of the spindle, and the upper end of the said tube of vulcanized india-rubber fits on about the middle of the conical collar on the under side of the cover. When, by turning the spindle, the valve is raised, the spindle rises in the cover, and the tube of vulcanized india-rubber is forced further on the two cones by the approach of the said cones towards each other. The advance of the cones into the ends of the tube of vulcanized india-rubber causes the said ends to fit more tightly on the said cones. Leakage can only occur by the liquid escaping between the ends of the vulcanized india-rubber tube and the cones on which they fit, and the act of opening the tap tightens the said ends upon the cones.

Instead of making the parts on which the ends of the vulcanized india-rubber fit of a conical figure, they may be made cylindrical, and of a little greater diameter than the spindle. In place of a tube or hollow cylinder of vulcanized india-rubber a series of rings may be employed, but it is preferred to use the tube as first described.

2361.—Louis Rudolph Bodmer, of 2, Thavies Inn, Holborn, London, for "*Improvements in gaseliers and in ventilating apparatus connected therewith.*" Provisional protection only obtained. Dated Sept. 21, 1861.

The object of this invention is to prevent the heat, smoke, and other products of combustion, resulting from the use of gaseliers, from entering and mixing with the air of rooms, and to carry them off, and thereby prevent the injury, arising from the ordinary mode of lighting by gas, to pictures, books, decorations of rooms and other objects, as well as to health.

These improvements are chiefly applicable to gaseliers with two and more burners fixed to, or suspended from, the ceilings or roofs of rooms or buildings. The burners may be placed vertical, as in ordinary gas-lights, but, it is preferred to use the star-shaped gaseliers with horizontal burners. The gas-pipe, to the end of which the star is fixed, is placed within a second pipe or tube of larger diameter, and this second tube is a ventilating-tube which carries off the products of combustion, sufficient space being left between the two tubes for their rapid escape. The upper end of the ventilating-tube may pass through the roof into the open air, where it is covered with a suitable cowl or hood, to prevent back draught, or it may terminate between the ceiling and the floor above it, and enter into a flue leading into the open air—the chimney, or some suitable part of the building. The lower part of the tube terminates a short distance above the star, where it enters into or opens upon the aperture of a globe or other mantle of glass, spherical or bell-shaped, or of the shape of an inverted funnel, the larger end of the mantle embracing or covering in the jets of lighted gas. This mantle or cover may be supported on brackets attached to the star, or it may be supported by chains or otherwise; and it may be open at the lower end, or covered up by a dish or bottom perforated to admit air, or air may be admitted between the rims or edges of the mantle and the bottom. This bottom is likewise made of glass. The gas-pipe and the ventilating-tube may be telescope-jointed, for the purpose of lengthening and shortening. It is also proposed to make the cover and dish so as to overlap each other, and to cause the air to pass between the overlaps, whereby it will become heated on its way to the gas-flame. When required, a circular disc of glass or of mica is placed horizontally above the star, reaching to or beyond the burners, to conduct the air to the flame. The gas, during its passage through the ventilating-tube to the burners, becomes likewise heated to a certain degree.

In clusters of perpendicular burners, each burner may have a separate globe or chimney, covered with mica or otherwise, and the whole cluster covered by one mantle or globe. In gaseliers with long arms, in which the burners are a considerable distance from the centre of the gas-pipe, it is proposed to cover each separate flame with a globe, and to carry the products of combustion from each flame through a separate ventilating-pipe to the centre or main ventilating-tube surrounding the gas-pipe. It is also proposed to form an air-passage through the ceiling of rooms round the ventilating-tube, and leading to the off-flue, for the purpose of additional ventilation in such rooms. Owing to the entire absence of smoke and other impurities, reflectors can be fixed at any convenient place above the lights.

2363.—Henry Cockey and Francis Christopher Cockey, of the Frome Iron Foundry, Somerset, engineers, for "*Improvements in apparatus employed in the manufacture of gas.*" Patent dated Sept. 21, 1861.

This invention relates to a peculiar arrangement connected with those parts of the apparatus employed in the manufacture of gas for lighting and other purposes known as the dip-pipe and hydraulic main, and its object is to allow for the contraction and expansion or rise and fall of the ascension-pipe, and thereby prevent the strain upon the joints of these pipes, and upon the mouth-pieces of the retorts.

According to this invention, it is proposed to fix in the hydraulic main a short flanch-pipe, sufficiently long to give the necessary seal for the dip-pipe, and this pipe is to be bored out so as to allow the dip-pipe to pass through it. The outside of the dip-pipe is to be turned to fit the short pipe truly, but allow it space to shift easily through it as the ascension-pipe expands or contracts. In fixing the pipes, the lower edge of the dip-pipe should extend about a quarter of an inch below the outer pipe.

The claim is for the combination with the hydraulic main of a pipe or socket through which the dip-pipe may shift freely, for the purposes hereinbefore described.

2377.—Joseph Jacob, of Brünn, in the Empire of Austria, but at present residing in Golden Square, W., London, in the county of Middlesex, for "*Improvements in the mode of, and apparatus for, obtaining and treating hydrogen gas, and the application thereof to various purposes, parts of which improvements are applicable to the manufacture of iron and steel.*" A communication from Carl Preisenhammer and Carl Weniger, both of Zöptau, in the Empire of Austria. Patent dated Sept. 23, 1861.

This invention relates to improvements upon, and new features connected with, the invention for which letters patent were granted to the present patentee, bearing date the 9th of March, 1861 (No. 593), and consisting in the mode of obtaining hydrogen gas and its application to various purposes. The hydrogen is obtained in the manner described in the said patent, by passing steam over iron in a finely-divided state and heated to a red heat, the iron thereby absorbing the oxygen from the steam and liberating hydrogen, which is conducted to and collected in suitable holders or receiving vessels. Instead of using retorts, as described in the former specification, he prefers to use revolving retorts, or to fit in stationary retorts a suitable number of moveable trays, whereby they are divided into compartments suitably arranged one above the other, through which the steam is made to circulate. These trays may be formed of sheet iron or of cast-iron plates resting on suitable ribs or other projections. The plates are coated with a solution of clay previous to putting the iron required to be heated upon them; by that means the iron is prevented from adhering to the plates. In addition to the increased surface thus obtained, this mode of employing a number of trays has the important advantage of permitting an almost uninterrupted production of gas, owing to the facility and rapidity with which trays can in succession be removed from the retorts and replaced by others filled with metallic iron. When a suitable quantity of iron in a finely-divided state has been put into a tray, a few minutes are sufficient for heating it to the temperature required for the decomposition of the steam. The steam is then made to come into contact with the heated red-hot iron by means of pipes suitably arranged, and is decomposed into hydrogen and oxygen; the former is conducted into a condenser and from thence to the gasometer, and the latter forms a compound with the heated iron. Should the iron contain sulphur, phosphorus, and other substances which at the temperature of the retort are capable of combining into gaseous compounds with the liberated hydrogen, the latter will at the same time act as a purifier and liberate the iron, or rather the compounds of iron with oxygen, from these substances. Should the iron, on the other hand, contain carbon, silicium, aluminium, calcium, magnesium, manganese, and other substances which at the prevailing temperature would combine with oxygen, then these substances would become oxidized with the iron, and, at the same time, increase the quantity of hydrogen, because some of these substances, such as silicium and carbon, are, owing to the difference in their equivalents, as also in consequence of the difference in their relative capacity for oxidization, capable of liberating a much larger quantity of hydrogen. The oxides of iron produced as described and purified at least from such substances as sulphur and phosphorus, which, as is well known, have a highly injurious effect on the quality of the iron, may be employed with the greatest advantage in the various branches of the manufacture of iron and steel, and will enable a better quality of iron to be produced at a cheaper rate than the methods heretofore employed. These pure or comparatively pure oxides may be converted into iron or into steel by adding to them a larger or smaller proportion of a reducing and carbonizing substance; they are easily reduced, and the process can be performed in the cupola, in which the oxides may be melted down, either alone or mixed with pig iron; and the purified oxides may, in like manner, be melted in the blast-furnace, either alone or in combination with iron-ores or natural oxides. The conversion of the oxides into steel depends on the proportion of carbon employed, and this process may be performed either by means of the crucible as usual or without the use of crucibles, by means of the gas process, as will be hereafter described.

The hydrogen gas which has left the condenser and been conducted into and collected in the gasholder, can be employed for lighting and various heating and manufacturing purposes, as hereinafter described. The gas should be conducted to the condenser directly from the retorts, for the purpose of being freed from the undecomposed steam with which it is mixed, and which partly originates from the boiler, and partly is formed in the retorts themselves. The hydrogen gas—namely, when it comes in contact with red-hot oxide of iron, forms steam by a process of reduction. This steam, which issues from the retorts, together with the gas, passes into the condenser, and is there condensed into water. With the water in the condenser, another object is attained—namely, the purification of the gas from such gaseous combinations as, for example, sulphuretted hydrogen, and phosphuretted hydrogen, &c., the power of absorbing which the water possesses. As, however, a certain quantity of water can only absorb these combinations to a certain degree, care must be taken so to arrange the condensing apparatus that the gas comes uninterruptedly in contact with water possessing unimpaired power of absorption, so as to obtain for the former the greatest possible purity. This can be very easily accomplished by enlarging the condenser itself, and by providing it with a suitable arrangement for receiving a continuous supply of fresh water and carrying off the used water.

One way of employing hydrogen gas as fuel, is to use it as an auxiliary, and that without mixing it with air. It can, therefore, be introduced into the flames of puddling, smelting, and annealing furnaces, where it finds a sufficient quantity of unconsumed oxygen; also, into the flames of reverbatory furnaces for re-melting iron, and for all heating processes in general, in which it effects, under any circumstances, a saving in the consumption of fuel, and insures greater purity in the flame. But, when the hydrogen gas is to be used as a direct heating agent to the exclusion of every other, and it is desired to produce a very high temperature, as, for instance, in all metallurgical processes of metals not easily melted, as iron, copper, &c., the hydrogen gas must be burned, combined with atmospheric air.

A mixture of hydrogen and illuminating gas, or the latter alone may

be used and burned in combination with either air or oxygen, or with a mixture of air and oxygen.

The burner, which it is preferred to make of iron, is so arranged that the compressed air passes into the gas-flame, whereby the most perfect combustion is attained. For this purpose, the burner consists of two tubes, one of which is placed within the other. The outer tube serves for the passage of the gas, the inner for that of the air. Both tubes are conical at the end, the external cone of the inner tube fitting into the internal cone of the outer tube; the bore of the inner tube is cylindrical, and sufficient space is left between the inner and the outer tube for the passage of the gas. Therefore, by advancing and withdrawing the air-pipe, which can be performed by means of a very simple mechanism, the opening for the exit of the gas can be regulated with the greatest exactness. The general regulation is performed by means of the gas and air-cocks, which are fitted to the respective conducting-pipes, but as near as possible to the place of combustion. The suitable proportion of gas and air, as well as the attainment of the highest temperature, can be discovered from the presence of the heat itself, and also from the circumstance that, when composed of the right proportions, the gas mixture burns with only a very slight noise. In this case, when as above said, the exact quantity of air necessary for the complete combustion of the hydrogen is being supplied, the flame is in a neutral state with regard to the product undergoing the process of melting. From the above-described arrangement of the burner, it follows that it is very easy to increase the issue of either the air or the gas, and thereby to produce a flame of either an oxidizing or reducing nature, which for the majority of metallurgical processes is of the greatest importance. In order that the burner may not suffer in consequence even of the greatest heat, it is advisable to provide it with a suitable water cooler, both to the gas and air, as already mentioned, pressure is applied. As regards the air pressure, any of the various apparatus at present in use for this purpose may be employed. For effecting the pressure of the gas, it is preferred to use an exhaustor.

The furnaces which are used with this method of heating by gas, differ from those hitherto made, in this alone, that they consist only of the so-called melting-chamber, and, consequently, require neither fire, space, nor chimney.

Another part of this invention consists in mixing the non-illuminating hydrogen gas with such gaseous compounds of carburetted hydrogen which contain an excess of carbon over the hydrogen, and which, therefore, if burnt alone, have an imperfect combustion, permitting a large amount of carbon to escape in the form of somke. By mixing such gaseous compounds which contain an excess of carbon with the hydrogen gas, this evil is obviated. Such compounds of carburetted hydrogen exist in all the various descriptions of tar-oils, resins, and fatty matters, and also in all descriptions of coal from which gaseous compounds of carburetted hydrogen can be produced.

The hydrogen can, therefore, easily be used with the now-existing mode of coal-gas generation, and with this advantage, that the greater part of the compounds of carburetted hydrogen are transferred into permanent gases, which at present are condensed to tar, being unable to form permanent gases; at the same time, the hydrogen gas operates advantageously in quickly forcing forward all compounds of carburetted hydrogen contained in the retorts, which, by the present method, are decomposed into gases of less illuminating power, in consequence of remaining too long in the heated retorts.

The above-named substances are placed in a retort or other suitable vessel, and are heated to that degree of temperature at which their gaseous compounds become liberated, whereupon the hydrogen is passed into the retort, and combines with the gaseous compounds of carburetted hydrogen, and this new coal-gas, consisting of a combination of carburetted hydrogen ($C_n H_n + H$), is conducted from the retorts to the gasometer. The liquid compounds of carburetted hydrogen, such as tar and oil, and other similar substances, are conducted into the retorts in a continuous stream, regulated by a cock or tap; and, in order to increase the heating and evaporating surface, the said retorts are partly filled with pieces of burnt clay, pumicestone, coke, or other substance. The flow of hydrogen into the retort is likewise made continuous, and regulated by a valve or cock. In this process, the hydrogen will sometimes in its passages through the retort carry off with it small particles of undecomposed tar or oil, which, if not arrested, would accumulate and stop the free passage in the pipes; to prevent which, the combined gases before reaching the pipes, are passed through suitable coils of pipes surrounded with cold water, in which coils of pipes the said particles of undecomposed tar or oil will become deposited and flow to the reservoir which holds the oil or tar, and which supplies the retort or mixing-chamber. Care must be taken to free the hydrogen gas from all traces of undecomposed steam before it reaches the retort, as any such admixture of steam will result in the formation of carbonic oxide, whereby the illuminating power of the gas is impaired. I prefer, therefore, to obtain the purified hydrogen from the gasholder, where, having already passed through the condenser, it is perfectly pure.

The coal-gas issuing from the mixing apparatus, and which may be considered as a mechanical compound of carburetted hydrogen and hydrogen ($C_n H_n + H$), may, without undergoing any further purification, be at once distributed to the burners. The illuminating gas thus produced is free from sulphur and ammonia, and contains merely traces of carbonic oxide, and it is, therefore, independently of its greater purity, also far superior to the ordinary coal-gas as regards its illuminating power. It is well known that the ordinary coal-gas becomes deteriorated by being kept in the gasometers beyond a certain time, whilst the illuminating gas produced as described, being distributed for consumption immediately after its production, and the gasometers containing moreover hydrogen (H), and not coal-gas, its illuminating powers remain unimpaired.

The water-gas, commonly so called, which has in the present time become known, is only in so far analogous to hydrogen gas, as both are produced from water. The modes of preparing the two gases differ essentially, as do also their chemical properties.

In the process described for producing hydrogen gas, the oxygen of the water is absorbed by the iron, and its component parts form with the iron solid compounds or combinations, whilst sulphur and phosphorus form compounds of sulphuretted and phosphuretted hydrogen (S H and P H_3), which are absorbed in the condenser. The gas is, therefore, pure, with the exception only of slight traces of carbonic oxide (C O). In the production of the so-called water-gas, the whole of the oxygen of the water is absorbed by the carbon, and forms carbonic oxide (C O) and carbonic acid ($C O_2$), the principal portion of which latter is, however, in passing over heated coal, transformed into carbonic oxide (C O), which becomes mixed with the liberated hydrogen; the water-gas contains, therefore, a mixture of carbonic oxide, carbonic acid and hydrogen ($C O + CO_2 + H$).

When both gases are used to generate coal-gas by mixing them with compounds of carburetted hydrogen, it follows that the coal-gas generated with this hydrogen must be purer than that generated with water-gas; but, in consequence of the method of the generation of water-gas, which is always rich in carbonic oxide, the illuminating power of coal-gas generated with water-gas is much less than that of coal-gas generated with hydrogen.

Hydrogen gas, produced as described, is employed as well as the compound of the hydrogen with the illuminating gas for the filling of balloons, and the explosive compounds of two parts of hydrogen, with five parts of atmospheric air, and which is applicable for most of the heating and melting purposes, for the purpose of blasting rocks and mines, and for like purposes, the gas being filled into suitable holders or receptacles, and ignited by the electric battery.

The claims are for—

1. The use and application of the hydrogen gas, with or without the illuminating gas produced with the hydrogen, as a reducing medium for the manufacture of metals, and the production thereby of improved qualities of metals, as herein described.

2. The use and application of the hydrogen gas for the production of illuminating gas, by mixing the same with volatile compounds of carburetted hydrogen, as described.

3. The mode of employing hydrogen gas, by transforming the same into illuminating gas immediately before its distribution to the gas-pipes and burners, as described.

4. The use of the simple condensing apparatus for the purification of the hydrogen gas, as described.

5. The improved mode of manufacturing iron and steel by employing purified oxides, as herein described.

6. The production of cast-steel in furnaces without the employment of crucibles, by the application of the gas-melting process, as described.

7. The use of hydrogen gas in combination with atmospheric air or oxygen, for blasting, as described.

2396.—Thomas Richardson, of Newcastle-upon-Tyne, chemist, for "*Improvements in the manufacture of muriate of iron for the purification of coal-gas.*" Provisional protection only obtained. Dated Sept. 25, 1861.

These improvements consist in dissolving the burnt sulphur ore, left as a waste product in the manufacture of sulphuric acid in muriatic acid, and evaporating the solution to dryness, or in drying up the solution with sawdust, charcoal, small coke, gypsum, the waste burnt sulphur-ore ground to powder, or any natural oxide of iron in powder, and in employing any of these mixtures with lime or magnesia, in the usual way, in the purification of coal-gas.

2412.—William Clark, of 53, Chancery Lane, in the County of Middlesex, engineer and patent agent, for "*Improvements in the manufacture of peat.*" A communication from abroad by Auguste Marcelin Manrique Comte de Lara et du Ren, engineer, of 29, Boulevart, St. Martin, Paris. Patent dated Sept. 26, 1861.

The patentee states, that after many years of study and experience, he has found that certain defined combinations, however varied in their proportions (which are determined either by the slow but progressive decomposition of peat in water, or by the much more energetic and rapid action of the atmosphere when the water is expelled, and the body reaches the last stage of decomposition) are the real causes of the inferiority of peat as a fuel. One result of these combinations, viz., that produced by water, constitutes, to a certain point, the essence of the body, and determines its nature; hence, the natural combinations can only be neutralized by decomposing them, and by forming new equivalent chemical combinations. In a commercial point of view, nothing practical would result from such a mode of improving the peat as a fuel; and, after having minutely studied the question in all its aspects, during which he has made many very curious and interesting discoveries of a purely scientific nature, he has been led to conclude that the above-mentioned combinations should be allowed to remain as they are; as, together, they count but little among the causes of the inferiority of the peat as a fuel. When searching for other combinations forming the real cause of the inferiority, he has found that these various combinations, the number of which was sufficient to appal one at first sight, are formed some instantaneously, and others gradually, and are determined the one by the other in such manner, that if one combination be wanting, or if one of the constituent parts of the one or other should disappear or be disturbed, the nature of the whole will be radically changed. Thus it can almost be asserted that it is one single combination only, whose elements are rapidly and progressively modified, in proportion as the hydration of the body becomes more or less modified. In this manner, it will be easily understood that the object to be attained is to find a method of arresting the formation of any one of the said combinations.

The distinctive feature of this invention thus consists in destroying, so to speak, the constituents of the primary combination to prevent its forming as far as possible, or of so changing its nature that it shall no longer produce the same effects. This result is obtained without the aid of any new chemical combinations, and, as in the present invention it is only the purely chemical treatment of the product which is considered apart from the general treatment necessary for insuring its success, it will not be thought unnecessary for more perfectly comprehending the process, to mention that peat is found in two different states, one when decomposition is produced by the action of water, and the other when deprived of water, and it is exposed to the action of the atmosphere. The decomposition in water gradually produces several chemical combinations, the first deriving their origin from the phenomena of the decomposition of

organic bodies in general when in a wet state, which is arrested at a certain moment by new combinations peculiar to this body, and determining its nature. By exposing peat to the action of the atmosphere, a considerable number of combinations are determined almost instantaneously with great rapidity, which result in lessening the caloric power of the peat by modifying the primitive combinations of carbon, ammonia, and hydrogen. The latter combinations are all produced by the simple action of what is termed "contact," as the agent which determines the effect of the action of the atmosphere does not form any real combination with the constitutive bodies; as, for instance, when producing fermentation, or in other cases the agent employed produces energetic action without combining therewith. These effects have been attributed to the action of the total decomposition of the peat, but it is beyond doubt that this neither changes nor modifies the constituent parts. The progressive modification in the state of the hydrogen which accompanies and determines the progress of the constituent parts, but does not alter their nature; a physical agent like the action of the atmosphere, is the origin of the whole series of combinations produced during this latter period.

In order to neutralize the effect of these combinations, various weak solutions are employed, not for the purpose of producing any chemical action, but simply for effecting the action of contact. The results obtained are: first, the peat, after its extraction, is placed in a subdividing apparatus. Secondly, water is added during such subdivision, containing quicklime in the proportion of from three to five pounds for every 250 gallons of the peat. Thirdly, the subdivided peat unground is passed out of the apparatus in a liquid state into a special reservoir, into which is poured, while the peat is being deposited therein, a solution in the proportion of bisulphite of liquid soda, 1 part; water, 50 parts. Fourthly, when the reservoir is full, the peat is pumped out, and flows by means of channels into special reservoirs, to be there ground or compressed. Fifthly, on leaving the channels, the liquid peat has added to it a solution composed of alum of commerce, 1 part; and water, 200 parts. The bisulphite of lime is employed in the proportions of bisulphite of lime, 1 part; and water, 52 parts. The effect is much more active than when using bisulphite of soda; but the high price of the former causes it to be used very rarely. When the peat is required to be compressed, there is added, in the reservoirs above mentioned for receiving the subdivided material, a small quantity of a weak solution of sulphate of strontian. It will be understood that, when working on a large scale, sufficient motive power is required, as also suitable apparatus for facilitating operations, and capable of acting on large quantities of the material at one time. The subdivision of the peat is necessary, otherwise the action of the solutions would be too slow, and they would also require to be sensibly modified, care being also taken to prevent the production of a definite chemical combination. The patentee states that he has also succeeded in dispensing entirely with mechanical agents by suitably modifying the solutions, the result on a small scale being most satisfactory, the quality of the product being superior, while the increased expense caused by the modifications in the solutions was more than compensated by dispensing with the subdividing or other apparatus. But, when working on a large scale, he has found that this mode of treatment could not be rendered practical, as the action of the solutions becomes slower, in proportion as the mass to be treated is augmented, and that this is notably increased beyond the proportion in which the material is augmented.

The peat thus treated is of a perfect black colour for the first three days, and, on the fourth day, the black changes to a reddish hue; while, in about a fortnight, the peat will be brown on the exterior similar to the colour of tobacco, and a clear yellow in the interior. Three weeks after, the black colour returns, and finally the interior becomes of a permanent black colour with bright cracks, and the exterior assumes a chocolate hue. The mean density should be from one ton to a ton and a quarter per cubic yard.

APPLICATIONS FOR LETTERS PATENT.

1304.—Alfred Vincent Newton, of 66, Chancery Lane, London, W.C., mechanical draughtsman, for "*Improved electrical apparatus, applicable to the lighting of gas.*" A communication. May 2, 1862.

1306.—Joseph Brierley, of Blackburn, Lancashire, borough surveyor, for "*Improvements in the construction of fire-plugs or valves, to be used in extinguishing fires, or for other purposes where water is required to be drawn from mains under pressure.*" May 3, 1862.

1311.—Jean Marie Herdevin and Joseph Alexandre Jullien, ingénieurs, 13, Rue Gaillon, Paris, for "*Improvements in sluice-cocks.*" May 3, 1862.

1332.—Christopher Binks, of Parliament Street, Westminster, London, S.W., for "*Improved methods of obtaining hydrogen gas, and certain gaseous compounds of hydrogen and of carbon.*" May 5, 1862.

1358.—Eugène Bourdon, of Paris, mechanical engineer, for "*Improvements in the construction of blowing-fans, which improvements are also applicable to centrifugal pumps for raising water and other liquids or gases, or for exhausting the same.*" May 7, 1862.

1385.—Leo De La Peyrouse, of 13, Panton Square, Haymarket, London, W., manufacturer, for "*Improvements in treating neutral and acid fatty or oily substances, resins and resinous substances, and compounds or products containing paraffine.*" May 8, 1862.

1404.—Robert Moore, of Cannon Street West, London, E.C., engineer, for "*Improved apparatus for indicating the pressure, position, or accumulation of liquid gases, or vapours, and apparatus for preventing danger or damage consequent thereon.*" May 10, 1862.

1414.—Henry William Sambridge, of Birmingham, Warwickshire, manufacturer, for "*Improvements in sliding chandeliers, gaseliers, and other pendent lamps.*" May 10, 1862.

1439.—Gideon Blake, of Trowbridge, Wilts, engineer, for "*Improvements in apparatus for warming apartments.*" May 13, 1862.

1443.—William Clark, of 53, Chancery Lane, London, W.C., engineer and patent agent, for "*Improvements in apparatus for generating motion in fluids, applicable for raising and forcing water, propelling and otherwise, in the distribution of motive power.*" A communication. May 13, 1862.

GRANTS OF PROVISIONAL PROTECTION.

1149.—Alexander Parkes, of Liverpool Street, Birmingham, Warwickshire, for "*Improvements in surface-condensers.*" April 19, 1862.

1191.—John Endean, of Lock's Fields, Walworth, London, S., brass-founder, for "*Improvements in cocks, taps, and valves.*" April 24, 1862.

1195.—William Denny Ruck, of 8, Duke Street, London Bridge, London, S.E., merchant, for "*The manufacture of grease from coal-tar, coal-oil, creosote, or deal oil.*" April 24, 1862.

1231.—Squier Cheavin and George Cheavin, both of Boston, Lincolnshire, for "*Improvements in filtering and purifying water, and in apparatus employed therein.*" April 26, 1862.

1234.—Herbert William Hart, of Higher Broughton, Manchester, Lancashire, engineer, for "*Improvements in the manufacture of reflectors and shades for gas and other lights.*" April 26, 1862.

1248.—James Eglinton Anderson Gwynne, of Essex Street Wharves, Strand, London, W.C., engineer, for "*Improvements in the construction of centrifugal pumps, and in the application thereof, parts of which improvements are also applicable to other pumps.*" April 29, 1862.

1284.—Henry Willis, of Albany Street, Regent's Park, London, N.W., organ-builder, for "*Improvements in valves, for the supply and discharge of gaseous bodies.*" April 30, 1862.

1288.—William Bickford Smith, of Camborne, Cornwall, merchant, and William Bennett, of Tucking Mill, Cornwall, engineer, for "*Improvements in the method of, and apparatus for, preventing the injurious effects occasioned by smoke, sulphur, and the deleterious gases which escape from stacks, chimneys, calcining-houses, chemical and other furnaces.*" May 1, 1862.

1304.—Alfred Vincent Newton, of 66, Chancery Lane, London, W.C., mechanical draughtsman, for "*Improved electrical apparatus, applicable to the lighting of gas.*" May 2, 1862.

1306.—Joseph Brierley, of Blackburn, Lancashire, borough surveyor, for "*Improvements in the construction of fire-plugs or valves, to be used in extinguishing fires, or for other purposes where water is required to be drawn from mains under pressure.*" May 3, 1862.

1332.—Christopher Binks, of Parliament Street, Westminster, London, S.W., for "*Improved methods of obtaining hydrogen gas, and certain gaseous compounds of hydrogen and of carbon.*" May 5, 1862.

1358.—Eugène Bourdon, of Paris, mechanical engineer, for "*Improvements in the construction of blowing-fans, which improvements are also applicable to centrifugal pumps, for raising water and other liquids or gases, or for exhausting the same.*" May 7, 1862.

NOTICES TO PROCEED.

3243.—Thomas William Atlee, druggist's factor, of Birmingham, Warwickshire, for "*Certain improvements in cocks or taps for drawing off liquids.*" Dec. 27, 1861.

3264.—Neil M'Haffie, of 16, Summer Street, Mile End, Glasgow, N.B., for "*Improvements in ventilators or valves for regulating the passage of air or other fluids, whether of a gaseous or liquid form.*" Dec. 31, 1861.

11.—Benjamin Rhodes, of Old Ford, Bow, London, E., for "*Improvements in forming or making straight and bent pipes and bends for pipes, and also vessels of various shapes, and in coating and protecting objects and articles of various forms, and in the apparatus to be employed therein.*" Jan. 1, 1862.

14.—Edmund Francis Davis, of Tavistock House, Tavistock Square, London, W.C., for "*Improvements in gas-burners.*" Jan. 1, 1862.

163.—Louis Martin, chemist, of No. 13, Rue Gaillon, Paris, for "*Improvements in the treatment of mineral oils, and in the apparatus connected therewith.*" Jan. 22, 1862.

759.—Frederick Warner, of 8, Crescent, Cripplegate, London, E.C., for "*Improvements in cocks or taps.*" March 18, 1862.

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, May 5, 1862.

The Wakefield Water and the Windermere District Gas Bills were read a third time, passed, and sent to the Commons.

The Bradford Corporation Water and the Heckmondwike Gas Bills were read a third time, with amendments, passed, and sent to the Commons.

Thursday, May 8.

The Barnsley Local Board of Health Bill was reported, with amendments.

The Stretford Gas Bill was read a third time, passed, and sent to the Commons.

Monday, May 12.

The Bradford Corporation Water and the Heckmondwike Gas Bills were returned from the Commons, with the amendments agreed to.

The Barnsley Local Board of Health Bill was read a third time, with amendments, passed, and sent to the Commons.

Injury from Noxious Vapours.—This subject was referred to the following Lords, who will form a Select Committee, and sit on Friday, May

16, at twelve o'clock:—The Duke of Richmond, the Earl of Derby, the Earl of Shaftesbury, the Earl Graham, the Earl De la Warr, the Earl Grey, Lord Wodehouse, Lord Ravensworth, Lord Wrottesley, Lord Stanley of Alderley, Lord Monteagle of Brandon, Lord Belper, Lord Talbot de Malahide, Lord Chelmsford, and Lord Egerton.

TUESDAY, MAY 13.

The BOLLINGTON (PRESTBURY) IMPROVEMENT AND LIGHTING Bill was reported from the Select Committee, with amendments.

THURSDAY, MAY 15.

The HALIFAX CORPORATION Bill was reported, with amendments.

FRIDAY, MAY 16.

The Royal Assent was given to the BRADFORD CORPORATION WATER and the HECKMONDWIKE GAS Bills.

The EAST LONDON WATER Bill was returned from the Commons, agreed to, with amendments. The said amendments were considered, and agreed to.

The BOLLINGTON (PRESTBURY) IMPROVEMENT AND LIGHTING Bill was read a third time, passed, and sent to the Commons.

HOUSE OF COMMONS.

MONDAY, MAY 5, 1862.

The KENT WATER Bill was read a second time and committed.

Two petitions were presented against the HIGHWAYS Bill.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Grantham Water-Works Company, the Lewes Gas Company, the Brierley Hill District Gas Company, the Penzance Gas Company; and five others.

TUESDAY, MAY 6.

The EAST LONDON WATER Bill was reported, with amendments.

A petition was presented against the HIGHWAYS Bill.

POLICE AND IMPROVEMENT (SCOTLAND) Bill.—Two petitions against this bill were presented.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Weston-super-Mare Water Company, the Wolverhampton New Water Company; and another.

WEDNESDAY, MAY 7.

The READING AND READING UNION GAS COMPANY, the WAKEFIELD WATER, and the WINDERMERE DISTRICT GAS Bills, were read a first time, and referred to the Examiners.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Durham Gas Company; and two others.

THURSDAY, MAY 8.

The CATERHAM WATER and the BRISTOL WATER Bills were reported, with amendments.

A petition was presented against the HIGHWAYS Bill.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Crystal Palace District Gas Company, the Stockton and Middlesborough Water Company, the Bideford Gas Company; and four others.

FRIDAY, MAY 9.

The Lords amendments to the BRADFORD CORPORATION WATER and the HECKMONDWIKE GAS Bills were agreed to.

Two petitions were presented against the HIGHWAYS Bill.

POLICE AND IMPROVEMENT (SCOTLAND) Bill.—A petition was presented against the Bill.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the New River Company, the Epsom and Ewell Gas Company, the Newport Pagnell Gas Company, the Cardiff Water Company; and one other.

SATURDAY, MAY 10.

A petition was deposited against the LIVERPOOL CORPORATION WATER Bill.

MONDAY, MAY 12.

The EAST LONDON WATER Bill, as amended, was considered, and ordered to be read a third time.

The STRETFORD GAS Bill was read a first time, and referred to the Examiners.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Nelson Gas Company, the Newport (Mon.) Gas Company; and another.

TUESDAY, MAY 13.

The LEEDS NEW GAS Bill was reported, without amendments, and ordered to be read a third time.

The BRISTOL WATER and the CATERHAM WATER Bills, as amended, were considered, and ordered to be read a third time.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Cardiff Gas Company, the Crediton Gas Company, the Torquay Gas Company; and four others.

WEDNESDAY, MAY 14.

PAROCHIAL ASSESSMENTS Bill.—Petitions against the Bill were presented from the Maidstone Gas Company and the Carshalton Gas Company.

PAROCHIAL ASSESSMENTS Bill.—Mr. Ker Seymer was discharged from further attendance on the Select Committee, and Mr. Alderman Salomons was added thereto.

THURSDAY, MAY 15.

The LEEDS WATER Bill was reported, with amendments, and ordered to be read a third time.

The FALMOUTH WATER Bill was reported, without amendment, and ordered to be read a third time.

The EAST LONDON WATER Bill was read a third time, and passed, with amendments.

A petition was presented against the HIGHWAYS Bill.

POLICE AND IMPROVEMENT (SCOTLAND) Bill.—A petition was presented against the Bill.

PAROCHIAL ASSESSMENTS Bill.—Three petitions were presented against the Bill.

FRIDAY, MAY 16.

The LIVERPOOL CORPORATION WATER Bill was reported.

BARNSLEY LOCAL BOARD OF HEALTH Bill.—The Lords amendments were agreed to.

The BRISTOL WATER Bill was read a third time, amendments made, and Bill passed.

The LEEDS NEW GAS Bill was read a third time, and passed.

Three petitions were presented against the HIGHWAYS Bill.

PAROCHIAL ASSESSMENTS Bill.—A petition against the Bill was presented from the Over Darwen Gas Company; and another.

HOUSE OF COMMONS.

UTILIZATION OF SEWAGE OF TOWNS.

(*Continued from page 257.*)

MONDAY, MAY 5.

The committee reassembled this day—Dr. BRADY in the chair.

Mr. *King*, examined by the CHAIRMAN.

I have been engaged in laying down carriers, for the purpose of sewage irrigation, on the catch-meadow principle, at various places. I have executed works at Dunse (Scotland), Wimbledon, and at the Sussex County Lunatic Asylum, Hayward's Heath. At one of these places (name not heard), the proprietor informs me that the result of the application of sewage irrigation has been, not only to increase the quantity of milk supplied by his cows, but to improve the quality of his butter, for which he obtained 1d. per lb. more than adjoining farmers. He also found it advantageous for feeding beef. I do not think the principle of surface-carriers is applicable to growing crops. Arable land should be supplied by underground pipes. In reference to grass crops, I have found that, not only is the quantity increased, but the quality is improved by sewage irrigation. I have had an opportunity of studying the Edinburgh meadows. Ground which was very strongly irrigated would not suit grass for hay making; the grass would require to be cut very often. In some of the Edinburgh meadows, they cut it as many as seven times in a year. Mr. Beaumont obtained for his grass, last summer, £3. 10s. an acre for the first crop, for hay making; £3. 10s. an acre for the second crop, to feed cows; and the third crop was worth at least £3 an acre for his own cattle. Cattle are very fond of sewage grass, and will feed on it immediately after the land is irrigated. In a general way, I think the best mode of applying sewage is by flexible hose. I do not exactly know the value of London sewage. I am aware that it is of a very fertilizing character, but I do not know its value as compared with guano. I have seen some of the analyses of London sewage, but, as I am not a chemist, I have not gone into that part of the subject. I think small dressings of sewage are preferable to large ones. The latter make the crops too gross. To cut as green food, I think 2000 tons per acre may be very profitably employed for grass, but not to exceed that. I have not had any experience as to the application of solid manure, but I have no doubt that a given quantity of solid manure would have a two-fold benefit if diluted, and applied in solution to the land. If you put solid manure upon land when the atmosphere is in a dry state, it may be there for weeks, and be half wasted.

The CHAIRMAN: Alderman Mechi told this committee that land which had been two years under Italian rye-grass, with 2000 tons of London sewage per acre, might be taken liberties with, and that, from such land, six exhausting crops in succession might be obtained. Do you agree with him on that point?

Witness: I do not think it would be wise to run the land in that way.

The CHAIRMAN: A very experienced gentleman said here, that it was the duty of the farmer to use all exhausting crops. Do you agree with that?

Witness: No; I do not see the object of it. If you have got command of manure, you may grow just what crops you please.

The CHAIRMAN: He also stated that, from an acre of Italian rye-grass so manured, he would expect an increase of at least 24 tons.

Witness: No doubt of it. I have seen as much as 40 tons per acre from one crop of meadow-grass at Edinburgh.

The CHAIRMAN: From your experience, would the works you speak of pay a farmer to execute, if he could get the sewage at 2d. per ton?

Witness: Yes; I think 2d. per ton would be a fair price for a farmer to pay. I think it would pay very well.

Mr. PAGET: Will you give us the grounds upon which you say that at 2d. per ton it would pay?

Witness: Because it produces a certain quantity of grass with a certain quantity of sewage; and I have made calculations to show that it would work out that.

Mr. PAGET: Can you give us those calculations? You have said that 2000 tons of sewage might be applied per acre, and that 2d. per ton would be a fair price to pay for it—that is something like £17. In what way would you make the application of £17 worth of sewage per acre pay the farmer, because to that is to be added the expense of your engineering plant, &c.?

Witness: The extra crop of rye-grass during the first two years would be sufficient to pay it. I have seen the works at Lochend. I do not know the circumstances attending it there.

Mr. PAGET: I will tell you. In the first place, the land was ploughed and tilled for an early crop of potatoes, exceedingly liberally manured; and, the potatoes being dug up, the land was sown with Italian rye-grass. It then, if I remember right, had guano in addition, and then the application of sewage. Now, do you know what would be the produce of the land without the manure, in rye-grass treated in that way?

Witness: I could not say exactly; it would not be anything like so much.

Mr. PAGET: But a farmer would know that it would be a very heavy crop without sewage; and the question is, can you show an increase of produce equal to £17 per acre, which is what you would have laid out in sewage at the rate of 2d. per ton?

Witness: The Italian rye-grass at Lochend realized in 1860, for the first crop, £30; and, in the second year, £35. I can show that they produced in three years £106 per acre. I do not think any other manure would do that.

By Sir BALDWIN LEIGHTON: I do not know the profit and loss upon the transaction; I only know that £106 was received. There would be but little expense, as the crops are sold standing.

By Mr. BLENCOWE: The cost of laying out 17 acres at Hayward's Heath has been £3 per acre. There are between 400 and 500 lunatics in the asylum. The works were finished about three weeks back. The water, after passing over the meadows, flows into a brook; there is very little of it. It does not discolour the stream.

By Colonel FANE: I was brought up as a farmer. I have not farmed since 1836. I got the information respecting the value of the grass at the Lochend farm from Mr. Beaumont himself. [Witness produced samples of the three crops of common meadow-grass. The first was about 2 feet 6 inches high; the second, 2 feet; and the third, 18 inches high.] I am sure that 40 tons per acre of Italian rye-grass cut green may be grown under sewage irrigation. I have seen it in Mr. Thompson's meadows, at Edinburgh: and he told me he expected the second crop would yield 25 tons; the third, 15; and the fourth, 12—making 92 tons per acre in all.

By Mr. GREGSON: I should think the value of the 92 tons would be nearly £50. The sewage costs them nothing; it is thrown down upon them in large quantities, and, if they did not use it, it would run to waste. I think, farmers would readily buy sewage at 2d. per ton. I should propose conveying it from cities and towns by underground pipes, and along the roads generally. I think the quantity of sewage per annum is about 38 tons per head of population. I have not made any calculation as to what the reduction in the rates of Brighton would be, supposing the sewage of that town were sold at 2d. per ton. The value of the sewage would be about £20,000 a year. I think, it could be sold readily to the farmers. I have communicated with some of the largest farmers in the neighbourhood. Lord Chichester, whose land is about three miles from the town, is favourable to its application; and Mr. Beard, who has several thousand acres of farm adjoining the town, says he should be glad to apply it. The sewage would require to be pumped up to the top of the hill, from whence it would flow by gravitation on to the land.

By the CHAIRMAN: If there were a plentiful supply of sewage, I believe it would be a paying speculation for the landowners to lay down pipes and apply it.

The CHAIRMAN: We have it in evidence that everything could be done complete for £1. 15s. per acre; do you think the benefit to be derived would pay for that?

Witness: I do.

Mr. PAGET: Would you undertake to put down sufficient pipes and hydrants to work the land at £1. 15s. per annum?

Witness: No. The plan I have been adopting is the catchwater system. I have no experience in laying down pipes, but I have seen a great many instances of it. I have seen the Rugby meadows.

The CHAIRMAN: We have it in evidence that as much as 8400 tons of sewage per acre have been placed upon the Edinburgh meadows. Do you consider that too much?

Witness: I consider it would be very wasteful to put on sewage in that quantity, supposing they were not obliged to have it. I think 2000 tons are ample. I do not think it need be all absorbed, if it is run over the land; there would be some benefit in it for other land, after it has flowed away. I believe the solution is of much more benefit than the solid matter. The effect upon the crop does not depend so much upon the quantity which is passed over the land, as upon the quantity that is absorbed. This—[producing sample]—is a specimen of the second crop of Italian rye-grass, cut at Lochend on the 5th of June last. It is 4 feet 6 inches high. It is used entirely for green food; it would be useless for hay making.

The CHAIRMAN: What is your opinion as regards the application of sewage upon ordinary grass-land? Do you think it has much beneficial effect for hay?

Witness: I think it is the best manure that can be put upon any land.

The CHAIRMAN: If sewage is much diluted, do you, from your experience, know whether the manurial properties are destroyed?

Witness: You cannot take anything from the sewage by adding water to it; you only gain greater facility for spreading it over the land.

The CHAIRMAN: Then you would say that no matter how diluted the state of the sewage is, it is still capable of giving manurial properties to the land?

Witness: I think so until it is all absorbed. I think there is so much held in solution that you cannot take it all away till it is absorbed, provided it does not pass over too rapidly.

By Mr. BLENCOWE: There is not a great quantity of sewage at Brighton at present, as there are not many drains. I think 20 tons might be pumped up 300 feet for 1d.

By Mr. GREGSON: I believe the amount required for drainage works at Brighton is £70,000. About £20,000 more would be sufficient for the necessary machinery and works to convey the sewage on to the land. There would be a great saving in the local taxation by the use of it, and it would be a matter of importance to the corporate body there to undertake the works.

James White, Esq., M.P., for Brighton, examined by the CHAIRMAN.

I shall be happy to tell the committee, what is my experience of Chinese agriculture in connexion with the application of sewage. It so happens that the whole manuring in China is by the application of liquid sewage. The Chinese have an idea that manure, whether the production of bipeds or quadrupeds, if applied in a dry state burns the land. They also say, you do not require to manure, or, as they put it, to fatten the land: what you want is to grow the plant. Therefore, they do not manure the ground but the plant. They do not, as we do, manure the land for sowing the crop: they apply the liquid manure only while the crop is growing. It is rather to us a matter of surprise, when we land in China to find that horse and cow-dung—horse-dung particularly—is of no value unless contiguous to pasture-land, of which there is little in China. They will not use horse-dung on arable land, because they say that the seeds of the weeds consumed by the horse are not destroyed in its stomach; and, if they were to put the dung on arable land, they would be filling the ground with weeds. In reference to cow and buffalo-dung——

Colonel FANE: I think this has nothing at all to do with the question before the committee—which is, whether sewage is applicable in England, where the climate is very different to what it is in China?

Witness: I should say that there is every kind of climate in China. There is greater severity of cold in some portions of the country, where I have passed a part of my life, than there is in England. Understand that I have nothing to prove by making these statements.

Colonel FANE: Exactly. I should not have thought of interrupting, but, it appeared to me that the difference in the climate of China would make the question of what was done with sewage there altogether a different thing to the question of its application in England, and that therefore it was a matter with which we had nothing to do.

The CHAIRMAN: I think the honourable member had better proceed.

Witness: With reference to cow-dung, it is applied for dyeing, and in the arts only, and has a higher value in that respect than if applied to manurial purposes. Indeed, unless there were pasture-land contiguous to the place, where cattle are kept, they would lose as much as they would gain by its application. Then the question comes, how is the inexhaustible fertility of China maintained at its present rate? It is by appropriating what we waste in Great Britain? The process which they adopt in applying sewage in China is one which I do not recommend to be followed in this country. The market-gardeners, who bring in the vegetables for the supply of the towns, employ the same buckets in which the vegetables were brought to carry away the contents of the house refuse-pails; and I need not say that, from a residence in that part of the world, I have found that it is not particularly agreeable to perambulate the streets early in the morning when this operation is going on. To show the value attached to this refuse, I may mention that it is the perquisite of the hall-porter of the house, who is paid for it by the persons who bring in the vegetables in the morning. In the corner of almost every field there is a tank, into which the daily contributions are emptied. The way in which the sewage is put upon the field is this:—they take up a small quantity in a scoop, and put it into a bucket of water; and, when it has become very diluted, the cultivator throws it over the plants. The time for doing so is usually near sundown, and any one walking through the country at that time will feel that, if they would only put covers on these receptacles, they would prevent a great nuisance. With regard to the effect of the irrigation, or rather the distribution of the liquid sewage over the land, the smell is not perceptible after the lapse of a few minutes. To show the value which they attach to this system, I may say that, when we first arrived in China, our residence was near one of these public places, and the nuisance was so great that we complained to the authorities, and asked to have it removed. We were told that the question of manure was a national question in China, and that to the abundance of it and its application to the land they owed the cheapness of food. These places, we were told, were extremely valuable, and were bequeathed from generation to generation—that daughters were portioned from them, and sons inherited them as part of the patrimonial property; so that, if we wanted to get rid of the nuisance, we must buy the place at its mercantile value, which could easily be ascertained.

The CHAIRMAN: From your experience as to the use of sewage in China, do you think it important to this country that sewage should be applied to agricultural purposes?

Witness: I cannot say, but I should think it must be of great value, when I know how many thousands of persons are employed in China in the collection of it. In the south of China it is collected as an article of commerce, and carried principally to the sugar-growing districts, where it is applied, in a liquid state, to the cane. I may also mention that the horticulturists apply it, especially urine, in a diluted state. They think it adds greatly to the brilliancy of the bloom. In fact, human excrement is the only manure employed.

The CHAIRMAN: They look at it in a national point of view. Do you consider it so here?

Witness: I confess I have not given my attention to the subject. It has always struck me that the application of liquid manure in this country is purely an engineering question as to the cost at which it could be applied, and the result. Some of my friends in Brighton say it is not sufficiently valuable to farmers to induce them to pay anything for it. I think I before said that, in China, they manure the plant, and not the ground. They apply it copiously to the corn when coming into ear.

By Mr. PAGET: In all their towns they have sewers, but these sewers are merely for the purpose of taking off the surface-waters; they never allow any of the sewage to go into them. They take that in the state in which it is produced, and, as I said before, the person who applies it dilutes it as he thinks sufficient. I should think he dilutes it with about six times its bulk of water.

Mr. PAGET: When we speak of 6 to 1 in one case, and 1000 to 1 in another, there is no comparison.

Witness: As I said before, I have nothing to prove. I have no experience; I am not an agriculturist.

By Mr. CAIRD: It is quite obvious that the population of China is increasing. The natural tendency is to increase; besides, we see the immense immigration from the country. Any one who has passed through China will not think it exaggerated when I say the population is from 350 to 360 millions. The land is generally alluvial, but the soil is very superficial. They never plough deep, and they concentrate all the manure on the plants. I never saw them apply plain water—the market-gardeners do. I have seen the system of irrigation with excreta applied at considerable distances from towns. The whole country is permeated with canals, by which the carriage of it is facilitated. The Chinese have a great notion of the value of aquatic plants as manure; and, in the autumn of each year, they dredge the rivers, to obtain these aquatic plants, and apply them to the soil.

By Mr. GREGSON: Dry sewage is never used. Tubs are appropriated to each house, for the reception of the sewage; and the man who brings the vegetables to the family takes away the contents, which are placed in the reservoir attached to the field of the agriculturist, and allowed to lie there till required.

By the CHAIRMAN: The urine is included. It was thought that the sale of guano would be wonderful in China, but no one would buy it, because they said they could manure their land much cheaper with excreta.

THURSDAY, MAY 8.

The CHAIRMAN stated that he had received a communication from Mr. Evans, solicitor to the Birmingham Gas Company, who wished to make a statement in reference to some evidence given respecting Birmingham.

Mr. *Evans*, examined by the CHAIRMAN.

I am the solicitor to the Birmingham and Staffordshire Gas Company. The refuse that was formerly objected to consisted of "blue billy." It was what remained after purifying the gas with wet lime. Wet lime is used in connexion with many gas-works, but we purify with dry lime and peroxide of iron. The dry lime is sold to farmers. In the process of purification, it becomes charged with sulphur, and it then becomes valuable to the sulphur manufacturers. The only other thing that was objectionable was the ammoniacal liquor. That liquor is now sold to manufacturers; but I am not

sure what they make of it. Tar is sold by us for purposes of distillation, but I know nothing of the distillation as used in the works. All I know is, that they have generally the power of using it to any excess. When the disposition of our refuse has taken place, I think the disposition of the second process would be objectionable as it escapes from our works; so that its coming second-hand from our works would do just the same damage as at first. The general purport of my evidence is, that all our sewage is of commercial value. In answer to question 1750, it was stated that in the main of our works the "billy fluid" was found in the stream; but I cannot state what that "blue fluid" is. I have made very diligent inquiries about this affair, and I believe we have no such thing in connexion with our premises. If any such fluid comes, it comes from some other factory. I believe it is mixed with sulphur.

Mr. ADDERLEY: Can you state, of your own knowledge, that there is no exuding of refuse into the town that would be injurious to the health of the inhabitants?

Witness: I am not a gas-maker, and would not like to take upon myself to answer that question.

The CHAIRMAN: But you found the dry lime with the peroxide of iron produces certain chemical changes—what as to that?

Witness: I should be sorry to answer a question which I do not understand.

By Mr. PAGET: The tar has been manufactured into saleable products in South Staffordshire for a great many years. I am instructed that nothing was put into the sewers by us for the last year or two; and I am told that, whatever was done to injure the land by that means, was done by other parties. The price at which we sell the gas-tar varies; but it is of such great value that we sell it readily, and there is a great demand for it.

By Mr. CAIRD: It is certainly never thrown away.

Mr. PAGET: Then, if it was ever spread upon the land, it was quite a mistake?

Witness: Quite a mistake.

Sir *Joseph Paxton*, M.P., examined by the CHAIRMAN.

I have paid considerable attention to agriculture and horticulture, and am also a farmer myself. I have also paid attention to irrigation, but there is no intention here of opening up much of the irrigation subject, because that is not before the committee. I have paid considerable attention to the inquiry, so far as the horticultural subject is concerned. The mode of applying manure to plants should, in my opinion, be applied in the old form. Therefore, the application in the sewage form is the quickest way in which plants can be best supplied. Sandy soil is the best for the purpose. It is the soil that will allow a very large quantity to pass through it without artificial drainage. Where there is artificial drainage, sometimes the liquid manure gets away and is taken away by the drainage, but where there is sand you have the very best drainage. I tried a tank close to my residence fourteen years ago, with the view of testing it with various kinds of land, and I found that generally I could place the sewage over an acre by 250 persons. I applied that again on their soils, but the water necessary for that was rather too much to produce all that one could wish for. In sandy soil, you can hardly apply too much sewage for vegetation. In land, you cannot do that, because it cannot pass off. Let me state to the committee some facts with regard to plants, which will aid them in their present inquiry. Plants develop matter for the food of man or animals to no great extent, unless there is a corresponding amount of light and shade. All plants produced in darkness, have a slowness of growth. Now, you often see an appearance in the spring of the year. You see a large development of the leaves of the plant which, to people generally, exhibits the appearance of a luxuriant plant, but it is only a development. The first development of a plant is growth, and its ultimate object is to reproduce itself; and, when it is in that state of reproduction, it wants a great amount of nourishment. Therefore, all sewage will be most beneficial early in the spring of the year, because, then the warmth of the sewage will be a great advantage to the soil, and thus you get a good per centage. If you have a large per centage to the amount of warmth you apply, it very often happens that that per centage is of little value. It is well known in horticulture, that there is a plant which you never think of watering with cold water. Tropical plants are watered to a high degree. I have watered plants of a tropical nature to 95 and 100 degrees of heat, and that with the most beneficial effects. When a plant is developing itself in the most luxuriant way, that is the time it requires hot water. I have tried experiments on the bamboo cane, in order to see the effects. That plant was kept very moist at top and bottom. It was in a high state of condition, and that plant, in twenty days, I have known to grow at the rate of 10 inches a day. Well, then, in the same proportion you may carry on a similar experiment, but you should always take, for the purpose of sewage, those plants which develop themselves with the least amount of temperature, in order, with sewage, to see the greatest effects. You can grow cress in a very short time, but, if you have Italian rye-grass, that is the very best in the way of experiment. I think the warmth sewage imparts to the land is most beneficial. Whatever it adds to the heat of the soil must undoubtedly be most advantageous. In tropical countries, the great growth is unquestionably caused by the great quantity of warmth in the soil. It is only within the last twenty years that plants have been so cultivated amongst us. Pine apple has been tried, and we have operated with effect upon its growth. Every plant is in the animal state for the purpose of its growth, and then the application of manure is of no advantage to it, but, as you go on, then you go on increasing a larger amount of the application of sewage almost to an unlimited extent.

The CHAIRMAN: If I understand you right, you would not apply more sewage than the land is capable of absorbing?

Witness: Oh, no; certainly not. There are, no doubt, some lands where you can apply a larger amount of sewage than upon others; but you can use the largest amount upon land which contains sand. Take the sewage of London, and apply that to the sandy parts. Why, the application of the sewage of London, if so applied, would make those parts worth £100 an acre, and would cause those parts to grow to the largest amount of growth. You know that a large extent of cotton mill, with a large extent of plant, will very often do more with the same expenditure than a smaller one. Under the same circumstances, one line of railway will do double the amount of another. In like manner, if you get land which will filter the water through, and so give you double the amount of growth, it naturally follows that the land will become the much more valuable.

The CHAIRMAN: Would you consider the application of your principle well founded, so far as sand is concerned—so far as water is concerned?

Witness: Yes; but I would like you to do that, if you could tell me how to do it. London contains 3 million persons, and, taken at a rough guess, you have some 40 gallons per person per day. Well, now, I need not tell you that 40 gallons, strongly impregnated with highly developed plants must be injurious. My view of the question is this: I would not touch the eye of a sewer at all on the north side at present, but afterwards it might prove valuable. In the beginning, I would take the low-level sewer as the best, then the middle-level sewer, and then I would take the high-level sewer. I would pump it up, and let it flow naturally. Fourteen pipes would carry something like 20 million gallons a day. I am not quite certain about that; perhaps 30 millions a day; and that taken, would be attended with three advantages. In the first place, you would place it upon land that is of itself very poor—worthless—valueless almost at the present time; secondly, you would improve that land, and raise it from its miserable state. And then, you would let this same water permeate through the sand into the bed of the Thames, and thus get it returned again, in which manner you would give London the advantage of having a larger flow through the City than it had before. It would all come back again; and thus the supply down the river would be equal to the quantity that came up. I was very anxious, when I made these experiments, to see how water could be made pure through the sand; and I found that, in passing through the sand at the depth of six feet, there was not a particle of impurity in it; and that would be the very best thing that could be done for London.

The CHAIRMAN: Would it not take so much from the material value of the sewage—that passage through the sand?

Witness: Not at all. The effect is almost magical. The moment it goes off the soil the impurity is absorbed in the surface; but that is a rough carpenter sort of business, to speak of the surface. You cannot put it into such a form at all times upon the surface, as that it can be applicable to scientific purposes. It would be advantageous to apply sewage to wheat and other crops, if you apply it properly. I think an application of sewage immediately after the plant is sown would be right; but, still it is astonishing how nature has met cases of this kind. She has protected these plants by some great law that we know nothing of the nature of. You see—probably have often seen—the vicissitudes that little plants go through, and yet survive. Different plants would require a different strength of sewage to be applied to them; but, of course I speak as a vegetable physiologist and farmer. For instance, I think that the Italian rye-grass has not been grown properly for the food of cattle. I believe it is necessary, after the plant is grassed, that it should cease to have water applied to it before it is applied for the food of cattle. It is well known that, if you continue to stimulate plants up to the day you take them out of the ground, you do not get such an amount of succulent matter as you would have if you gave them a little draught. There is no chemical analysis that ever was published which shows how that exactly is, but, it is well known that, if a plant is affected by the frost, that in not less than two days the whole circulation of that plant is all changed. It takes cold. Then it throws off that cold. It expectorates, so to say, but it does not cough; and this is all changed in a few days. This is a fact known to every gardener. It is a case which applies to maple, cedar, and many other things. In fact, if you have plants highly charged with manure, there should be a few days allowed before they are consumed. These days are absolutely necessary for their proper development.

The CHAIRMAN: Would you deodorize sewage?

Witness: Most undoubtedly I would, because there would be great complaints otherwise. Nevertheless, whether there were or not, I would not apply that universally. I am aware that sewage applied to land is shortly deodorized. At Sydenham—and I would not like the story to be told before the ladies, because they would not walk up the Terrace again, perhaps—we do it constantly. The sewage of the Crystal Palace is very considerable, because of the numbers of people who go there. In the front of the transepts at Sydenham there are large tanks. I proposed at first to put them in the front. I took the trouble to explain to them that I would cover the back of them over, and put a small pipe along. That was done, and now there is a pipe for these tanks, and also complete ventilation—so much so that there is not one jot or tittle of smell. In fact, the very beautiful scarlet geraniums are very often watered at four o'clock in the morning from that sewage.

The CHAIRMAN: Have you not tried to induce the farmers to take a portion?

Witness: Yes; but the farmers are one hundred years behindhand of horticulture. They have a right to be so, if they like. I do not want to force them at all; and, indeed, if I attempted to do so, I believe it would be a dead failure, so far as commercial speculation is concerned. The particular mode of the application of this sewage is the great point to which this committee should attend. As to its most important value, there can be no question of doubt. The excrementitious article is unquestionably the very thing for plants. Of all other manure, sewage manure is the very best. There can be no doubt about that.

Mr. PAGET: You have spoken of 2d. per ton: how would that apply at different seasons of the year?

Witness: Well, it would be worth 2d. per ton if it were applied in the months of April and May.

The CHAIRMAN: But in the autumn, how would it be?

Witness: Why, then you are approaching the winter, and plants do not develop themselves at that season; but, if you take grasses, why then absolutely in autumn there will sometimes be a development. But, if you take the round of the season—the months of March, April, and May—as corresponding with the three autumn months, August, September, and October, and take also into account the temperature of the growth of the plants, you will find that there is twice as much of growth in the autumn as there is in the spring. That is because the ground is warm. The great rains in the spring of the year cause your ground to be cold. In fact, the ground is then absorbed with frost, and whatever you do then to stimulate must have three times the effect that it ought to have at another period of the year. With mangel-wurzel, you would require a cessation of water at times. You would apply the sewage manure to that in September and August. Mr. Chadwick, who was at the Board of Health, and who took a very great interest in this question, made many experiments, and I gave him the result of those which I had made in 1851 and 1852, all of which were published.

Mr. PAGET: How many gallons of water do you generally apply?

Witness: It is astonishing the amount of consumption a plant will take of sewage when it is in a high state of growth. There are 1000 gallons applied to 250 acres.

Mr. PAGET: You say you find a peculiar absorbing power after passing through six feet of sand?

Witness: Yes; but that could not be done except by internal drainage. I do not think it could be done by artificial drainage.

Mr. CAIRD: I suppose that, in speaking of the sewage at 2d. a ton, you expect the farmers to apply it chemically?

Witness: Oh, certainly. At the same time, you must observe that I have kept myself as much as possible to a particular line of evidence, and that I have not entered into the chemical or engineering evidence at all.

I have made experiments when the sewage was highly diluted; and, indeed, there are particular times when the plants will not take it unless it be diluted. All plants require it, some in stronger and some in lesser quantities; but what I wish to impress upon you is, not to cut the grass immediately after having had the sewage applied to it. Give it a little ease. You have then those valuable properties left which can be best applied for the food of animals and man. I feed cattle entirely upon lettuce, and you might keep growing an endless quantity of lettuce to an acre.

By Mr. CAIRD: The sewage at the Crystal Palace is in an undiluted state in the tanks. Its mode of application depends upon the plant. If the plant requires it strong, then we apply it in a large form. We do not apply it to our grass-land there. The land there is not of a sandy character. It may be that the Thames water is less fertilizing now than it was in former times. I believe that at no distant period we shall have two distinct systems of sewage—sewage from water-closets, and sewage from washings. Here is London increasing at a most enormous rate, and soon there will be a very serious question arising as to where a sufficient quantity of water can be obtained. For my own part, I should like to see the water flow into the Thames again after it has been purified, for that would be a great public advantage. I have used guano for several years together, and the results of other manure by the side of it were quite equal. I have paid attention to sewage in all parts of Europe Now, at Ghent, they are taking the better kind of sewage in small tanks by railway, and that they do for a very considerable distance. They bring to the railway-trucks half a dozen or more of these tanks, which are carried thirty or forty miles into the country, and there they are fetched away by the farmers. Each tank is lifted off the truck into a cart, and then the farmer dilutes that manure with water in order to supply his plants. They have also a large quantity of iron boats, and those boats are filled with this sewage, and sent along the canals, and there the manure is sold to the farmers. I do not know whether that is a profitable sort of speculation, but I know they are making the sewage highly beneficial. It would be too strong to apply such manure to plants without dilution. They irrigate a valley 50 miles long at Valentia, in Spain, and they have a most enormous growth there. It is the most fertile valley I ever saw. The land is naturally poorish there; but, if it had anything like the sewage of London applied to it, the growth would be increased amazingly. What I saw there was better than I should have expected from water, although it was not water alone, for it was mixed with sewage. In Spain, the land is divided into several very small compartments, and they plough it in a most ingenious manner. The climate in Valentia is very different from that in England. I believe plans will be invented when sewage will be taken out of our houses without giving forth any offensive smell. The purer the form it is in, the more valuable it is. You will have single and double X's of it some day in London. In order to produce the best results, the land should be carefully laid out. I have visited the land of the royal commissioners at Rugby several times. I do not think the entire of the land itself has been productive there; but I do not wish to pass any opinion upon the way it was laid out. It is strong land, and they did not apply the sewage in sufficient quantities to it. I believe things are more satisfactory at Edinburgh. I know there must be a great difference of opinion as to the results of these matters. What I would suggest, if it could be done, would be this—and, after all, it is the most vital thing for our country, where we are spending so many millions of money—that the Metropolitan Board of Works should aid the operations under an agriculturist or horticulturist, in two or three different forms, and then we should have some known facts to go upon. At present, very many vary in opinion. I know they tried it at Rugby, but I would extend the experiments to various other places, and various other things. I think that would be a wise plan. It would take a large capital to apply the London sewage, and, though you find capitalists in the City ready to go into various schemes in all quarters of the world, yet, I believe, you would not find them enter into any speculation relative to the sewage of London. No doubt, if the Government were guaranteed 4 per cent., they would enter into it. Yet, it is something they do not understand. All they know about it is, that it is a very difficult question.

The room was cleared. On our readmission,

The CHAIRMAN announced that the committee had come to the following resolution—"That any evidence of plans not yet in use be postponed until the evidence be completed of the various modes in which the sewage of towns in great Britain is now applied to agricultural purposes."

Some general evidence was given as to the sewage of Hythe, and the mode by which it was deodorized, after which the committee adjourned.

MONDAY, MAY 12.

Mr. *Tregelles*, examined by the CHAIRMAN.

I am an engineer, and have paid attention to the question of the supply of water to towns. I have also paid attention to agriculture, and am now farming about 200 acres of land. It is chiefly heavy clay land, cropping out of the coal measures, which is always an inferior quality of land. The crops I grow are old land-grass, Italian rye-grass, wheat, oats, tares, swedes, mangel-wurzel, turnips, carrots, and chicory. I have applied sewage to old land-grass, Italian rye-grass, chicory, carrots, turnips, and cabbages. The sewage I applied might be called town-sewage; it was obtained from the dwelling-house, and also from a cow-house and stable. I should think it was stronger than the average town-sewage. Sewage varies very much, and what we want is a correct index of its value. At present, the opinions on the subject are too vague to enable us to form a correct estimate, in any case, without separate analysis. I have applied 350 tons per acre per annum of our own sewage, which, I should think, is 50 per cent. stronger than the average town-sewage. The result in reference to old land-grass has been to double the produce. I have not had sufficient opportunity of judging of the value of the application to Italian rye-grass. It was beneficial, but not so much so as to repay the cost of conveying it by cart on to the land. I give the preference to liquid over solid manure, as being the cheaper form in which to place it on the land. Some crops are more eligible for receiving liquid sewage than others. For pasture-land it is decidedly the best mode of applying it, as, in a liquid state, the sewage is ready to be at once taken up by the roots of the grass before the ammonia is carried away by the air. It also keeps the land warm in winter, for I find that during the time the water is flowing over it the grass begins to grow. My observation in reference to Italian rye-grass is, that there is scarcely anything to be compared to it; for, succulent as the plant is by nature, it requires a great deal of water. I should be cautious in using it to wheat crops, save in exceptional cases, and then I would give it in the form of a shower. I have done so on some of my land; and for all green crops I should do the same. For tares, it would be of extreme value after the crop is cut. I would not apply it to the crop of swedes, except in summer, when they have attained the size of a marble or a turnip radish; then I would give a considerable quantity. When the season is dry, and we have a good wheat harvest, the swedes are generally stringy and woody, and not so large as when we have an unfavourable harvest and a great deal of wheat. I should then use the sewage very freely on the growing swedes. I should also use it very largely on mangel-wurzel. I think there are very few days in the year in which sewage could not be applied with advantage. In the winter months, I should apply it freely to grass-land; and to Italian rye-grass, almost throughout the year. I would take it off the pasture-land about a fortnight or three weeks before I cut it for hay. During the summer months, in times of drought, and when we are wanting water for the root crops, I should give it judiciously, not flooding the land, but applying it according to the circumstances of the case. In that way, I believe, we could use up the sewage of an ordinary town with advantage. Cattle eat the grass with great avidity after it has been watered with sewage manure. It is remarkable how closely they will eat it, while they will reject spots on the field where their own droppings have fallen.

The CHAIRMAN: In the event of sewage being brought into general use, what, in your opinion, would be the best method of applying it to agricultural purposes?

Witness: That is a large question, and I should be glad to answer it with accuracy. The carriers by which the sewage is conveyed to the land should be of ample size. When the sewage is in great excess, I should apply it where the land is not in ridges, as they are inconvenient. Where I have seen it best applied has been on land which falls about 1 in 20 to 1 in 50. I have seen it applied well where the fall is 1 in 70. After the water has flowed over a certain portion of the land, there should be carriers to convey it to other portions. There should also be a reservoir-tank, to afford the farmer a supply whenever he wants it. The sewage should be supplied on a system of constant high pressure, as is done in the supply of water; but the main body of the sewage I should like to have flowing in a stream.

Examination continued: I have used a little guano every year to excite the seed in its growth. I should not like to use it on my grass-land year after year. I consider town-sewage contains nearly everything the land wants. It contains the ammonia which guano gives us; also, phosphates and soluble salts of various kinds, which are essential to replenish the earth, and give back to it what we are taking out of it.

The CHAIRMAN: Do you consider that, if sewage could be brought to the farmers, they would be led ultimately to purchase and use it?

Witness: Yes, I do; but it would require an arrangement to accomplish that, and bring it speedily about. You are aware that, in the drainage of land, we have suffered from want of capital. Application was made to Parliament, some years ago, and commissioners were appointed to lend moneys for the drainage of land. I apprehend, in this case, something similar would be required to enable towns to employ their sewage, and convey it to the land. I think the farmers would then use it.

The CHAIRMAN: Do you consider that sewage, however greatly diluted, would be useful as a fertilizer to the land?

Witness: A quantity of plain water, with a small quantity of enriching, fertilizing matter, will be generally valuable to a farmer; but he would prefer the sewage good.

By Mr. PAGET: I have visited Edinburgh, Carlisle, Leicester, Rugby, and Croydon, and seen the results of sewage application in those places. My experience is confined to the sewage of my own house. I should think the quantity of water mixed with it would be something like forty times the quantity of sewage.

Mr. PAGET: We are told that in town-sewage there is a thousand times the bulk of water, so that no very reliable results can be arrived at from your experiment.

Examination continued: I convey the sewage on to the land by pipes. We are in a coal country, but we do not get any of the coal-pit water. The water has iron in it. My farm is at Derwentfield in the north part of Durham, just overlooking the river Derwent.

By Sir B. LEIGHTON: My farm is underdrained. My apparatus consists simply of a tank; the sewage flows by gravitation. I have brick pipes underground, and cast-iron pipes on the surface. I suppose that the tank and laying the brick pipes may have cost something like £30, and the cast-iron pipes about £4 per acre. I have pursued the system for ten years on grass-land. I have not the means of putting sewage on the ploughed land. I believe that sewage is applicable to a great part of the land in England. It may be raised 100 feet high at a moderate cost. In all the places where I have seen it applied, it is below the towns. It is perfectly natural that persons should seek to apply it as cheaply as possible. At Carlisle, it flows over an extent of 80 acres, with excellent results in a pecuniary point of view. At Rugby, I suppose it has not answered in that way. I suppose it does not pay the local board for their outlay, but it does not follow that it is not a good thing.

Sir B. LEIGHTON: In how many places does it answer to the local authorities besides Carlisle and Edinburgh?

Witness: I doubt whether it answers extensively anywhere; but, it is early in the history of sewage for it to have become a paying and profitable concern. There are very great difficulties in the way in applying it on a large scale. Perhaps it would be wise for the committee to propose that it should be used in the case of small towns like Banbury, Dorchester, Launceston, or Bideford, which could be easily arranged for, and where the surrounding land would be much improved.

By Mr. ADDERLEY: In any case where the use of sewage could be made without mechanical appliances it would answer, but, where there are heavy mechanical expenses, we are under disadvantages directly.

By Mr. BLENCOWE: In my opinion, the catch-meadow system is best for grass, and pipes and hydrants for arable. I believe in certain cases the sewage may be lifted a considerable height and yet be valuable, but I should prefer it to be tried by gravitation first.

By Colonel FANE: The product of my grass-land was about one ton per acre before using sewage, and, after using it, two tons. The meadows were not irrigated with river-water before. I have not tried sewage mixed with ashes; I am not favourable to that system.

By Mr. CAIRD: I do not keep a large head of stock where I use sewage. There are six persons in the house, and six head of cattle on the farm. The sewage is applied to 4 acres. I use it on the land in alternate years. The other years the land is not manured at all, and the crop is not so good, but it has improved since I used sewage. One hundred million gallons of sewage might be raised 100 feet for £70, reckoning the cost of coals at 17s. 6d. per ton. That is merely the cost of coal and labour.

By Mr. ADDERLEY: I use solid manure for turnips, swedes, and potatoes. I think the liquid portion of town-sewage is far more valuable than the solid. In a sanitary point of view, the experiment at Leicester is successful, but pecuniarily it is a loss. I am told the value of the solid sewage there is £1. 10s. 9½d. a ton. Some sewage is more valuable than other; where they use sulphuric acid, it improves it. I apprehend some of the dyes would

be injurious to vegetation, but I am not sufficiently acquainted with the subject to answer. I should think the sewage of a town of 1000 inhabitants would be sufficient to supply 70 acres. It might be conveyed in an open conduit ten or fifteen miles, and still retain its fertilizing power.

By Sir FREDERIC SMITH: The sooner we can convey the sewage to the land the better. It would be carried with less loss in close pipes. I calculate the value of it at something like 2d. per ton. I have no hesitation in saying I should often like to buy it at that price.

By the CHAIRMAN: I should be satisfied with a dressing of 2000 or 3000 tons per acre. In many cases, unhappily, failure has arisen in utilizing sewage by attempts to precipitate it. It is much to be regretted that it has been tried upon so large a scale.

By Lord NEWPORT: At Leicester, they separated the solid from the liquid, and sold the former at £2. 5s. per ton. The farmers found it was not profitable, and ceased to take it. The consequence was, that it accumulated in large quantities, and they were glad to give it away by cart loads. As a chemical experiment, it was eminently successful in cleansing the town, but commercially it has been a loss of from £40,000 to £50,000. The liquid portion goes into the river.

By the CHAIRMAN: I should be inclined to give 2d. per ton for the ordinary sewage of London, if I had a good market for my produce.

Mr. *Henderson*, examined by the CHAIRMAN.

I belong to the Middlesex County Lunatic Asylum at Colney Hatch. The property there consists of 240 acres, 70 of which are under cultivation. The number of inhabitants in the asylum including officers and servants is 2150, and the sewage of the establishment is applied to the land. It is very poor soil; in fact, there is none of the original soil left. The bricks for the building were made upon the ground, and the earth from the foundations was put upon the land, so that the original soil is buried, in some places, 20 or 30 feet deep. I should think our sewage is not of the average strength. The stock upon the farm at the present time is 25 cows, 8 horses, and 180 pigs. The manure of the farm is not mixed with the sewage from the house. We have about 35 acres of pasture-land upon which sewage is employed: we also use it to our rye-grass, mangel, cabbage, and clover. The sewage is forced by steam power through cast-iron pipes laid from 18 inches to 2 feet under ground. The greatest distance to which it is forced is about one-third of a mile. We seldom grow wheat, and I have never applied sewage to that crop. We find generally that from 250 to 260 tons per acre are sufficient for one dressing, and we give two dressings a year, I consider that the application of sewage is of great benefit; whether it has a permanent effect upon the land, I can hardly say. We have applied it for the last eight years. I have never had the water which runs off from the fields examined, nor have I ascertained to what depth in the soil the sewage is absorbed.

By Mr. ADDERLEY: The quantity of sewage produced at the asylum is about 120,000 gallons per day. The liquid sewage is kept in a tank, which is cleansed out about twice a year, when we find a considerable deposit. We believe that deposit is of value, and mix it with mould. The sewage is delivered on the land by gutta-percha hose.

By Mr. CAIRD: It takes a man a whole day to apply the 120,000 gallons upon half an acre. I like the sewage better upon Italian rye-grass than upon pasture. The cows eat the sewaged pasture-grass with avidity; I do not think they are so fond of hay made from it. We apply the sewage to mangel and cabbage in the same way twice during the growth. To mangel we apply other manure, but not to cabbage. We grow very large crops of both. I should think the cost of labour and coals is about 10s. 6d. per day. About £800 was expended upon our apparatus. Our engine is of 8-horse power. The interest on the capital expended would be about 2s. 6d. a day. We get over the whole 70 acres in a year.

By Colonel FANE: I cannot tell the per centage of cost of keeping the engine in repair.

Sir B. LEIGHTON: According to your account, the expense is between £200 and £300 a year.

By Mr. CAIRD: About half of our sewage runs away. When the apparatus was erected, we had only about half our present quantity of sewage.

By the CHAIRMAN: The water supply of the asylum is about 60 gallons per head per diem; so that the sewage is very diluted. Our produce of hay is, as near as possible, 2 tons per acre; we feed the rest of the year. We have occasionally had two crops. I think it would be better to use the whole of the sewage; but our tank will only hold 60,000 gallons.

By Mr. CAIRD: We have never had any complaints of nuisance from the use of the sewage. The inmates of the asylumn are very healthy.

Mr. *Cuthbert Johnson*, examined by the CHAIRMAN.

I was one of the Commissioners of Sewers in 1852. I have directed my attention a little to the application of sewage to agricultural purposes, so far as I thought it desirable as a commissioner of sewers, and also as chairman of the local board of health at Croydon for three or four years. I should think the most profitable way of applying it to grass-land would be by irrigation. I have tried it at my own place in a series of small experiments which have been going on for the last fourteen years, and I have seen its application on a larger scale on some meadow land at Croydon, about two miles from my residence. The result of my small experiments corresponded with the larger ones which I have seen. The sewage from my house is carried on to some grass-land in my kitchen-garden. The house is situated about 45 feet above the level of that ground, so that the sewage is conveyed there by gravitation with great facility. The result was carefully ascertained for two or three years upon this small patch of land, which is about one-sixth of an acre, and there was considerable increase in the crop.

Colonel FANE: The experiment upon the sixth of an acre can be evidence of no value.

The CHAIRMAN: It would not be, if he had not seen larger experiments elsewhere.

Colonel FANE: I should think that, in a kitchen-garden, the effect of people continually walking upon the grass with their shoes, would do quite as much good as the sewage.

The CHAIRMAN: I understood that Mr. Johnson had turned his attention to other places, and could give some information to the committee. Are you in a position to give direct evidence?

Witness: No, not direct evidence. The evidence I have is only with reference to this small plot, which has been going on for the period I named.

THURSDAY, MAY 15.

William Miller, Esq., M.P., examined by Mr. CAIRD.

I am the proprietor of the Craigintinny meadows. There are about 200 acres which are irrigated by gravitation, and about 50 irrigated by the pumping application with steam power. The sewage is raised to an elevation above the level of the meadows, and then flows by gravitation. The meadows are situated at a considerably lower level than that part of the city of Edinburgh where the sewage is taken. Any person acquainted with the locality must be aware that we possess a great advantage on account of the great fall that exists between the city and the sea. The distance from the boundary of the city, where the outfall of the sewer is, I should think was about a mile or a mile and a quarter. The population of the city from which the sewage is supplied, is about one-third or one-half, or in numbers about 80,000. A large proportion of the sewage runs entirely away from us both to the north and also to the south-east, which is in consequence of the city being built on several hills. There is a great want of a perfect system of water-closets in the city; in fact, they scarcely exist, and until recently there were none at all. I think that no system of deodorization is applied to the sewage previously to its coming to my meadows. An establishment has existed for catching the contents of one of the sewers in a tank, and selling the deposits for agricultural purposes, and, indeed, has now been going on for some years I believe it still exists, but is not very successful. The quality of the sewage as it comes to me, at any rate, is not perceptibly deteriorated in quality from that circumstance. The sewage after it has left my meadows is not applied to others at a lower level, but flows into the sea. The system adopted is that of open carriers, and small open gutters. The whole surface of the meadows is divided into convenient patches for the purpose of irrigation, and also to facilitate the purchase of the grass by those who come to buy it. The sewage flows constantly both night and day; and, during the summer months, the irrigation goes on throughout the night; but, in the winter, some of the sewage-water passes to the sea. There may, in the summer months, be a little more water put over the ground per acre than there is in winter; but, as far as we find it practicable, we irrigate continuously, summer and winter. The quantity of sewage which passes along the main drain in the course of twenty-four hours differs very much. We are subject to heavy rains and storms, and to a continuation of dry weather, so that we are compelled to be very particular, and be careful to keep the sluices in such a position that we do not get flooded. It is impossible in the time of flood to apply the whole to the land, even if the area were very much larger. The quality of the soil to which the sewage is applied is very dissimilar. Between the road and the sea, or about 40 acres, it is entirely sand. Near the buildings, for about another 40 acres, is strong clay; and the other is fine agricultural land, so that we have every variety of soil in the meadows. Sewage is beneficial to each variety of soil, but I think I should prefer the sandy, as it possesses the advantage of allowing the pure water to percolate through it and pass away at a lower level. I do not think you could apply a greater quantity with advantage to a sandy soil than anywhere else; I should suppose the clay soil requires a larger quantity than the sand. It would be more economically applied to the sandy soil than to the clay, because, from its nature, it absorbs more; and I think, if I were going to apply sewage irrigation, I should prefer the sandy soil, from the circumstance of the ammonia coming in contact with the plant almost immediately, and the pure water percolating through passes away, leaving behind every kind of deposit upon and enriching the soil. With heavy clay land, you require more continuous irrigation. For instance, an acre that you can irrigate in three hours on a sandy soil, would take a longer time on the clay land, as it possesses less absorbent qualities. Upon the medium soil, there would be practically no difference. But it depends very much upon the season when we begin our first cutting; if it is a dry one, we have earlier grass and higher prices. I think the last day of March was the first day of our cutting this year, and we continued to the end of April. Some is not yet cut. I think the weight of grass obtained at the first cutting has been very well stated in the report of the commissioners; more correctly, perhaps, than I can give it. We irrigate the meadows immediately after the first cutting. The system of irrigation is this—The landlord holds the ground, and pays all the outgoings; he is also at the expense of the whole of the operations connected with the irrigation. The produce of the land is sold by auction to the highest bidder when the grass is thought to be ready. After that, the irrigation goes on uninterruptedly during the whole year, irrespective of the letting, the waterman being the servant of the proprietor. The whole produce of one year is sold at one time, and the land is then resigned into the hands of the tenant who holds it, for that year, and often for a number of years. The system adopted in Scotland is to dispose of agricultural produce by auction, and the purchasers seem to prefer to buy it by public competition. The tenants are so tenacious of their rights, that the proprietors servants do not venture on the land for any purpose besides that of irrigation. It is particularly advantageous to apply sewage-water to the grass immediately after it is first cut, and also if cut four or five times. I have no idea how many tons per acre are applied after the first cutting. Of course, you would not apply the water when the grass was long, because you would injure it, and a large amount of irrigation requires that there should be a great deal of sun. It is as essential with a large produce to expose it to the warmth of the atmosphere as to expose it to the water. I do not suppose that any tenant ever complained of having too much water put upon his land; but we have frequently had complaints that the waterman did not give them enough. Sewage is applied, on the average, twelve times a year. The period which elapses from the first cutting until the second is ready depends very much upon the caprice of the cutter. Some people want it cut oftener, and I have heard economical tenants say, it is better to cut three times than four. The grass sometimes gets one dressing, and sometimes two, between the cuttings. It is very difficult to say how many tons of produce are cut green in the whole year. Upon some acres there would be an extraordinary amount, while on others there would be much less. It would be impossible for me to say that 60 tons are not cut. I cannot say why there is so great a difference between the produce of one acre and another, but such is the fact; in some seasons, it is more uniform. Almost the whole of the meadows are drained by sub-drains. The price paid for the crops by the tenants varies much. You have heard of £40 per acre, but I should think there never have been more than two instances of such a sum having been paid, and I think one of those circumstances occurred in the present year. That would arise from various causes; for instance, if a man were jealous of losing his holding, he would, perhaps, bid a very high price for this quarter of an acre, and then people get hold of a mistaken notion, and think that the whole has been let at that price. I do not think a lot ever comprises a larger area than one acre; most of them are quarter and half-acre lots. The same tenant would take several lots in various parts; you will never find a man take them altogether. He offers such a price as the appearance of the crop seems to authorize. I think you can scarcely make any average of the returns from the irrigated meadows; it has been estimated that the rent is £25 per acre, but I believe that to be excessive. They have certainly improved very much of late years, but perhaps £22 would be an extreme average of the rental per imperial acre. I do not pay anything for the sewage itself. You are aware that some of this irrigation is very

ancient—a portion of it has existed for 200 years, and it has been increased from time to time. The produce of the meadows is chiefly employed for feeding milch cows in Edinburgh, and other places within six miles round. Farmers purchase it, but not to any great extent, as they are generally wealthy men, and grow their own produce. Other persons who have horses to feed buy it, and it is found to be good for them, but I think it is more suited for cows. The 50 acres to which the sewage is applied by pumping and steam power are in permanent meadow. The water is elevated about 18 feet. I am afraid I cannot give you the cost per acre of the steam power necessary to do that. The meadows so irrigated are very inferior to those which are irrigated by gravitation. There is no difference in the quality of the soil, except that they are what are called new meadows, and were made at great cost out of agricultural land. Every agriculturist must be aware that it takes many years to get land level and covered with soil, and made fit for irrigation, before it will produce even an ordinary crop.

Mr. CAIRD: Do you attribute the inferiority of those meadows to their having been recently laid down, or to the cost of the application of sewage, which leads you to give them a diminished quantity of water?

Witness: I think they are not laid down very well; and then it seems impossible to give the same quantity of water by pumping which they would get from the natural flow by gravitation. In the winter, when there is an abundance of water, it is never wasted, or should not be, but should be applied where available by gravitation. Where it has to be raised, it is pumped periodically only; and, of course, the water does not run in the night over these, as it does over the other surfaces. I think it is only fair to state to the committee, with regard to the pumping, that, though we have greater facilities than most people possess for the purpose, the meadows have not borne results in any proportion with those which are irrigated by gravitation.

Examination continued: After the water has flowed over the meadows, it runs down to the sea in nearly a clear state. Sewage is so diluted that all offensiveness is absorbed immediately after its application to the grass, so that you may walk over it, and not perceive any smell. I reside on a part of that estate for some time every year, at a distance of about one hundred yards from the irrigated meadows, and am never sensible of any effluvium. We are sometimes annoyed by the gas company putting refuse matter or gas-tar into the stream, which does the sewage the greatest injury; we smell that frequently. There is a fallacious notion entertained with regard to the smell of sewage. Two years ago, I had the honour of taking the Prince Napoleon over my land. The consul had told him there was a great smell; but, when he had gone over it, he said, "From what I have seen, I should not mind having it as near my *château* as it is to yours." With regard to health, it was proved in evidence given twenty years ago, that the barracks within half a mile were the most healthy of any in Scotland; and between my house and the barracks is all irrigated land. About 400 soldiers can be accommodated there; and it is intended to increase them, so that they may give accommodation for 1000. They have never complained of any nuisance arising from the meadows. The same answer applies to the population in the neighbourhood. Several families are living near the meadows, and their children are as healthy-looking as you would wish to see. Along the sea-shore, where the water passes after leaving the meadows, there is no disagreeable deposit, and the sea-beach is perfectly clean. There is a natural stream of water from Arthur's Seat, through which the sewage flows, and so it goes down to the sea. It would be difficult to produce a correct estimate of the quantity of water given annually; but I think the best meadows get about 9000 tons per acre. If the grass is cut very close, the water is seen on the surface after irrigation; otherwise, it is barely perceptible. The grass is pretty uniform meadow-grass. I believe it grows and seeds itself, and is carried by the wind. You will find nearly every variety of grass in some some parts of the meadows. For instance, you will find Italian rye-grass coming up, having seeded itself from adjoining fields, and intermixing with the natural grass.

Mr. CAIRD: Can you tell us the whole cost per annum of irrigating the 200 acres by gravitation?

Witness: I cannot tell; comparatively, for the value, it is not costly. There are not many persons kept for the purpose; about four or six men attend to the whole of the irrigation during the year. Then, there is the expense of cleaning and levelling, and the lines must be preserved, or the water will not flow. The annual cost of the part to which steam power is applied is very much greater, but I am not able to give you the difference; it has not, however, been a very profitable experiment. My land steward, who is a good farmer, has ploughed up a part of that land for arable purposes, believing that it would answer better than it does now. The price obtained for the produce has been small—about £7 or £8. There are certain parts of the land which happen to lie very advantageously, and grow exceedingly good grass; but other portions, either from the quality of the soil, or the want of water, do not do well at all.

Mr. CAIRD: If, in addition to the cost of the application by steam power, you had had to pay something for the sewage, would it have ceased to be profitable?

Witness: It would seem so, from the circumstance of the land being ploughed up. About 10 acres a year have been ploughed up; and I think that such is the case pretty much throughout Scotland. I have seen a great deal of irrigation, and am aware that there has been much money lost through pumping.

Examination continued: The greatest produce is obtained when the weather is warm. In the warm seasons, when the grass has been cut, and the roots quite white from the heavy crop, I have seen them become green in forty-eight hours. The time of the application of the sewage depends upon the tenant. The most successful tenants are those who watch when the waterman comes round, and just cut their grass before their time arrives, so that the water goes directly upon the cut grass. It is indispensably necessary that the time should be regulated for them to receive it, because it takes a whole month to irrigate all the meadows,

By Sir B. LEIGHTON: I pay all the rates and outgoings. The taxes are very heavy in Leith—about £6 per acre. There are no other expenses besides those I have named. The meadows were laid down by my predecessor, at very great cost. I should think the 50 acres must have cost, from what I have heard, more than £3000. The ground was good before—worth £5 an acre. The land in this district, and for several miles round, lets at a high rent for agricultural purposes. The comparative price of land in England and Scotland would hardly rule here. The value of the land now, I estimate at £15. It is not profitable—I can assure the honourable member that. My engine is of 15-horse-power. I do not know what it cost; it has been up for some years.

By Mr BLENCOWE: There is no sewage applied to that portion of the 50 acres which has been ploughed up, and which has resumed its arable character. We have applied sewage to arable land, but there is great difficulty in doing it. I doubt very much whether turnips would be benefited by it. The late Duke of Portland undertook the irrigation system, after he had seen the Craigintinny meadows. He took the whole of the sewage of the town of Mansfield, and conveyed it through a stream to the Clipstone Park meadows. He expressed to me repeatedly his opinion that there was no application of sewage manure equal to that of the application of it in a liquid state. He used it to cabbages and to grass. It has occurred to me that, upon arable land, the same system might be applied as in the districts where the land is warped—that you might have feeders, and catch the water, and allow it to deposit. The letting of the Craigintinny meadows takes place from the 1st of April, and they are resigned to the proprietor about the 10th of October, for the purpose of cleaning and repairing the gutters, and taking away the soil and weeds that have accumulated in them. There is no covenant in the letting as to the number of cuttings; the tenant cuts the grass at his discretion. I am satisfied that the meadows have now been brought up to their highest state of fertility.

Mr. BLENCOWE: I was going to ask, whether you thought you could maintain it?

Witness: I think they are on the wane. That has been evident for the last two years; but the margin is quite sufficient. It is a marvellous application of manure—not only in this, but in various other places—and we shall all come to it, I am quite satisfied. During the last winter or two, we have put 300 or 400 sheep on the meadows, and, under the care of a good shepherd, they have done very well. There have never been any cases of rot. From the 10th of October to the 1st of May following, the meadows are under my control. The £22 per acre is given for the produce during the time the tenants have them. I do not think there is any profit by putting the sheep on during the winter; but it treads down the soil, and fastens the roots of the grass. Various opinions have been given in reference to pipe-drainage, but I have a very strong opinion that any successful irrigation must be by open gutters.

By Mr. PAGET: The farm on which we pump was not laid out originally for irrigation. The £3000 was laid out upon it, in order to make it as valuable as the other land; but it was a failure. I do not say that I should not recommend the pumping experiment again. I think, on the flat lands of Essex, there is margin quite sufficient—taking it at half our produce—to pay for pumping. I have seen sewage applied to young wheat, but it is very difficult. It might possibly be put on with hose and jet; but, in our case, the land was so well cultivated and highly manured, that we did not require it. Another thing is, that, upon arable land, it makes furrows, and washes the roots of the wheat bare—and so it does with turnips.

Mr. PAGET: With regard to the sanitary effect, you stated that there was no smell perceptible. When I crossed the meadows, there was a very strong smell. Can you account for that?

Witness: I think there might be some perceived from the main sluices, when the whole of the water is running down.

By the CHAIRMAN: I do not think, if the pumping land were now to be laid out, it would cost so much as £60 per acre. I must say that I think it was badly done, and the result is, they do not produce grass equal to the meadows irrigated by gravitation.

The CHAIRMAN: You say the 60 acres were worth £5 per acre as arable land prior to the outlay, and they are now worth £15, which gives £18 per cent. interest upon the outlay. If so, why do you say it is a failure?

Witness: I was not speaking of its being a failure upon the money expended, but of the comparative results between the meadows irrigated by pumping and those irrigated by gravitation. I deal merely with the practical fact.

The CHAIRMAN: If you get 18 per cent. upon that which was imperfectly done, how much per cent. must you get upon the other land?

Mr. CAIRD: That is a question of the proprietors.

The CHAIRMAN: No; it is a question of the value of sewage.

Mr. CAIRD: He does not get any per centage.

The CHAIRMAN: If 18 per cent. can be obtained upon the outlay of £3000, the other land must be more valuable.

Mr. CAIRD: I understood the effect of his evidence was, that he found that the advantage of the application of sewage was not so great as to render it profitable in comparison with the results obtained from the land as arable land, and therefore he said he had ploughed it up.

The CHAIRMAN: I understood him to say it was a failure, and looking at that failure he thought it would not be wise to expend money in a similar way in other places. (To witness:) Now, considering that you have a clear gain of 18 per cent. upon those 50 acres, do you not think it would be a good speculation to use the sewage by steam power elsewhere?

Witness: Will you allow me to explain myself with regard to the position which is taken in the first instance? I wished to convey to the committee that, upon the principle on which the 50 acres had been so laid down, the results were not so satisfactory as in those which we might say were naturally laid down, and I should perhaps more correctly have explained myself by saying that it was a partial failure, because it stands to reason that if we can make more, or anything like as much, by the grass on the 50 acres as that on the other ground, we should not plough them up.

Mr. CAIRD (to the chairman): It strikes me you are over-estimating the produce of the 50 acres. I think Mr. Miller said, the produce was not worth more than £7 or £8 an acre.

The CHAIRMAN: No; in answer to Sir B. LEIGHTON, he said it was £15.

Witness: They were originally worth £5 as arable land. A portion of them remains in grass, and I should say that portion produced £15 per acre, as the value of the crop.

The CHAIRMAN: Supposing the whole had remained in grass, would it not be worth £15 an acre?

Witness: It did not produce that, or it would not have been ploughed up.

The CHAIRMAN: Does that portion that is ploughed up produce more?

Witness: Yes; and you will allow me to say, that £15 gross arable produce is not a very large amount, and I was speaking of gross produce when I was speaking of grass. On some part of that which is ploughed up, we calculate we get £30 per acre in the produce of potatoes.

The CHAIRMAN: Upon that showing, £30 per acre is a clear gain of £25 upon the original value.

Mr. CAIRD: He does not get his potatoes for nothing.

The CHAIRMAN: Can you tell us the cost of planting the potatoes per acre?

Witness: I take a great interest in agriculture, but it would really puzzle me to tell you.

Mr. CAIRD: I think it is not necessary; for, if you go into this, you must go into the whole question of the rotation of crops.

Examination continued: I have a great opinion of the value of sewage, but I have always borne in mind that some localities are more suitable for it than others. I very much doubt whether it could be applied with advantage to wheat. It is much better suited for grass than anything else. You

might apply it to grass-land for some years, and then plough it up, and grow wheat. No doubt the action of the air in conveying sewage by open gutters is to remove a portion of the ammonia and other valuable constituents, but that is the case in all agricultural operations; for instance, with farm-yard manure. I believe pipes are such a bother, that they are comparatively useless as compared with the open-gutter system. If the pipes could be kept clear with a certain pressure above, they might be successful, but I am not sure they would be profitable. I am more convinced than ever, from the evidence given before this committee, that land has the property of absorbing from sewage its manurial properties. I think it very doubtful whether you could thoroughly carry out the principle of applying to the land only so much sewage at a dressing as it is capable of absorbing. My belief is that the land would take a great deal more than it has been practically ascertained could be applied to it.

Mr. CAIRD: When you said you got £5 for the land before, and now got £15, you referred in the one case to rent and in the other to produce?

Witness: Just so. I was asked the value of the land before irrigating, and I said, for agricultural purposes, the rent was £5; and, when I said £15, I referred to produce.

Mr. CAIRD: Then, there is the cost of the produce. There is no 18 per cent.; nothing of the kind.

By the CHAIRMAN: I should be sorry to have the solid matter taken out of the sewage which comes to me. I think, it would deteriorate it to some extent; but it is so diluted that there is scarcely any solid matter perceptible. I suppose the chief value does consist in the liquid portion. The largest amount I have known to be obtained for the produce of the meadows was at the rate of £40. 18s. per acre. That was for a quarter of an acre; I believe a whole acre was never sold at once. That price was certainly not given on account of the quality of the produce, but from competition, or a variety of circumstances.

Mr. *J. Hope*, examined by Mr. CAIRD.

I am a farmer, residing near Edinburgh. I am acquainted with the system pursued at Craigintinny, and have attended auctions of the grass. In some cases, I am aware that 2000 tons of sewage have been applied per acre for eight or ten times, but those may be exceptional cases. I have observed the results. The medium soil produced the earliest crops; that land would be worth £5 per acre. The sandy soil would be worth 5s. an acre; and, in its present state, let to a cow-feeder, it would be worth £30. The cost of attending to the irrigating channels would not be £1 an acre—that would cover everything. The same number of cuttings are got from the sandy soil as from the loam—four, and the weight of produce from fifteen to thirty tons on the whole year. The produce of the sandy soil is not so much as the loam, but more than the clay land. It is sold to the cow-keepers in Edinburgh, Portobello, and Musselburgh, and is eagerly bought up by them. I believe, it is not good for feeding horses. I have never heard any complaints about the effluvium; the water, as it runs from the meadows to the sea, is perfectly clear. The health of the neighbourhood is good. The cowkeepers think the grass of these meadows is very productive of milk. I am not aware whether it makes good butter.

By Mr. PAGET: I have not noticed any falling off in the produce of the meadows during the last two years. They have not gone down in rent, which they would have done had that been the case. I do not think it would be easy to make the meadows better than they are.

By Mr. CAIRD: I grow nothing else but Italian rye-grass and clover. I sell what I can to the cowkeepers; and, before the Craigintinny meadows got to be what they are, my produce was worth £10 an acre more than it is now, the competition having brought it down.

By the CHAIRMAN: It is merely guess work whether 2000 tons per acre is a sufficient dressing. The quality of the land must regulate the quantity employed. I have never seen sewage applied to any other crops than grass to any extent. I do not think it would be beneficial to green crops—rather the other way. At Lochend, where, after two crops of grass they have ploughed up the land, they have found it wanted manuring, showing that the sewage does not stay in the soil.

By Mr. BRISTOW: It makes green crops grow soft in the straw, and would be very liable to lodge. We generally find they are too apt to do so.

By the CHAIRMAN: The £30 per acre would be the rent, the tenant doing everything. The expense of £1 an acre would be inclusive of the cost of putting the sewage on the land. It does not refer to land watered by engine, but by gravitation. I have seen hay made on the upper meadows. If the sewage were applied over double the quantity of land, the rents would fall, because the demand would be smaller. I do not think that much sewage passes away, nor do I think that much more could be made of it than there is at present. I have never examined to see how deep the sewage penetrates into the land.

By Sir B. LEIGHTON: The property would not be worth half so much to a farmer as to a cowkeeper. None of the coach proprietors in Edinburgh purchase the grass. Their horses are fed upon clover hay.

Mr. *Morton*, examined by Mr. CAIRD.

I am the editor of the *Agricultural Gazette* and the *Encyclopædia of Agriculture*, and have been for many years conversant with practical farming. I have lately visited the meadows in the neighbourhood of Edinburgh, Carlisle, Rugby, and Croydon. I have carefully investigated the particulars, and obtained, as far as I could, correct facts on the subject. I saw the first cutting this season in the Craigintinny meadows. I should think the yield would be from 9 to 10 tons. It was very soft, succulent grass; very thick at the bottom—so soft, that it lay over at once. I observed the system of irrigation adopted upon that portion; it is the common system of surface-irrigation. I compute the quantity of sewage applied at from 40,000 to 50,000 cubic feet at a single dressing. It is not generally applied more than once between the cuttings. I should think the quantity applied per acre is about 10,000 tons per annum. Assuming that the owner gets a certain value for his produce, and putting that against the value of the sewage he uses, I estimate that at 1d. per ton. The cost of applying it is very small; I suppose about £1 an acre. I was informed by the water-man that he and another man did the whole of it. I also learned that the expense of cleaning out the conduits is paid for by the stuff got out, which is sold as manure. I visited the Lochend meadows. There are 30 acres of old grass there. The lower part was not so good as the upper, the produce being worth from £13 an acre up to £20, while the grass on the sides was worth from £25 up to £38. I attribute the inferior results in the former chiefly to the want of proper drainage, and not to a deficiency in the supply of sewage. A well-drained soil, or one that is naturally pervious, is the best for receiving sewage. The grass is of the same kind as that at Craigintinny, and is sometimes sold by weight on the ground, fetching from 6d. up to 9d., and even 1s. per cwt., according to the demand. There is more water put over these meadows than at Craigintinny—I should think 30,000 or 40,000 tons per acre in the course of the year. It is done by open irrigation. There are 10 acres watered by underground pipes and hose. The water is forced through the pipes by a pump with a water-wheel 15 feet in diameter, which causes the pump to make from 15 to 20 strokes in a minute, and driving a cubic foot per stroke. There is no cost for power except the original cost of the apparatus. They give about 600 or 800 tons per acre at each application to Italian rye-grass, and keep it on for two years. They then plough up the land, and crop with potatoes. It is exceedingly light soil, and very rapidly absorbs the sewage. I was told that if the water was laid on in the ordinary way, by surface-channels, it would not flow 10 feet from the channels, but would sink into the ground. My impression is, that they do not put on manure after the rye-grass, and before sowing potatoes. They grow no corn on these meadows. [Witness described the systems adopted at Carlisle, Rugby, and Croydon, evidence upon which has been already given.] At Carlisle the sewage was without smell, whereas at Lochend and Craigintinny it was decidedly obvious. The grass at Carlisle was not so forward as at Edinburgh, which is attributable, I think, to much less sewage being applied; and I fancy the carbolic acid employed to deodorize it, and which has antiseptic qualities, to some extent checks the effect of the manure. If applied on the system of ridge and furrow, I think the irrigation would be better than that of allowing the water to lie flat on the land. The tenant assured me he was satisfied with the result of the application. At Croydon, the solid matters are taken out of the sewage. I was surprised that they got so small a price for it. The sewage is very inferior, on account of the removal of the solid matter and the supply of water being larger. The present tenant pours it on the land to an enormous extent, and is obliged to do so, as he is responsible for any nuisance arising from the sewage escaping into the river. There is a smell at Croydon, but not so great as in the Edinburgh meadows. The crops there presented the same appearances as those at Craigintinny a fortnight before. As a general principle, I consider it expedient to apply a large quantity of sewage over a limited area, because the fixed charges would be lower, and the results larger in proportion. I think the application of farm sewage in a liquid state is not extending. Practically, I would limit the application of sewage to land under grass, as it interferes with the other tillage operations on the farm. It is a nuisance, and should not be employed in the neighbourhood of a large population. The minimum of nuisance would be in its application in small quantities upon clay land.

By Mr. WHITBREAD: I should suppose that the *vis inertiæ* of farmers has been the chief cause in preventing the application of sewage more largely than it has been hitherto.

By the CHAIRMAN: Soils will absorb the fertilizing properties of sewage in proportion to the clay contained in their composition. A very porous soil might absorb an inch a day. I admit the annual value of the sewage to the extent to which it has been realized in the Edinburgh meadows; but the quantity passing over there is so enormous that that value is ascertained by multiplying the number of tons by 1d.

(*To be continued.*)

RETURN OF GAS AND WATER COMPANIES,

REGISTERED UNDER THE LIMITED LIABILITY ACT, FROM AUGUST 1, 1859, TO DECEMBER 30, 1861.

[*The Companies whose names are in italics have been either wound up, or are no longer in operation.*]

No.	Name of Company.	County.	Date of Registration.	Nominal Capital.
	ENGLAND.			
1025	Cricklade Gaslight, Coke, and Fittings Company	Wilts	1859—Aug. 16.	£ 1,000
1041	West London Junction Gas Company	Middlesex	Sept. 15.	13,500
1043	Whitwick and Coalville Gas and Coke Company	Leicester	" 16.	4,000
1046	Great Coggeshall Gas Company	Essex	" 21.	3,000
1047	Barmouth Gas Company	Merionethshire	" 21.	1,500
1054	Cuckfield Gas Company	Sussex	" 29.	2,000
1063	Royston Water Company	Cambridgeshire	Oct. 17.	2,500
1070	Brimscombe and Chalford Gas and Coke Company	Gloucester	" 27.	3,000
1098	Burton Gas, Coal, and Coke Company	Westmoreland	Dec. 5.	1,100
1100	Chesterton Gas Company	Staffordshire	" 6.	2,000
1102	Universal Lime-Light Company	London	" 7.	300,000
1107	March Gas and Coke Company	Cambridge	" 15.	3,500
1117	Bournemouth Gas and Water Company	Hants	" 23.	10,000
1119	Paignton Gaslight, Coke, and Coal Company	Devon	" 24.	2,500
1133	Redhill Gas Company	Surrey	1860—Jan. 11.	4,000
1143	Llanfyllin Gas, Coke, and Fitting Company	Montgomery	" 23.	2,000
1147	Fitzmaurice Light and Portable Gas Company.	London	" 24.	50,000
1151	Calcutta and Mutlah Water Company	Not stated	" 25.	280,000

No.	Name of Company.	County.	Date of Registration.	Nominal Capital.
1167	Worsboroughdale and Worsborough Gaslight and Coke Company	Yorkshire	Feb. 11.	2,500
1175	*Dover Consumers Gaslight and Coke Company*	Kent	" 16.	10,000
1176	Painswick Gaslight and Coke Company	Gloucester	" 17.	1,000
1178	Stow-on-the-Wold Gas and Coke Company	Gloucester	" 21.	1,200
1181	Middleton-in-Teesdale Gas Company	Durham	" 22.	1,000
1182	*Pemberton Gaslight Company*	Lancashire	" 22.	1,000
1193	Eckington and Mosborough Gas Company	Derbyshire	March 2.	2,500
1197	Hatfield Gas Company	Herts	" 6.	2,400
1198	Hindley Gas, Coke, Meter, and Fitting Company	Lancashire	" 7.	3,000
1217	Boroughbridge Gaslight Company	Yorkshire	" 28.	15,000
1222	Midhurst Gas Company	Sussex	" 30.	2,000
1224	North Bierley Gaslight and Coke Company	Yorkshire	" 30.	20,000
1234	Manchester Water-Meter Company	Not stated	April 12.	20,000
1236	Patent Bitumenized Water, Gas, and Drainage-Pipe Company	London	" 12.	20,000
1242	Milnthorpe, Gas, Coal, Coke, and Lime Company	Westmoreland	" 19.	1,500
1251	*Maidstone Spring-Water Company*	Kent	" 30.	30,000
1257	Hadlow Gas, Coal, and Coke Company	Kent	May 10.	1,200
1265	Wem Gaslight and Coke Company	Salop	" 21.	2,000
1269	Market Street Gas Company	Herts	" 25.	1,000
1272	Southborough Gaslight and Coke Company	Kent	" 31.	2,000
1273	*Spofforth Gas and Coke Company*	Not stated	" 31.	900
1288	Briton-Ferry Gas and Coke Consumers Company	Glamorganshire	June 13.	1,500
1289	Tattershall and Coningsby Gas and Coke Company	Lincolnshire	" 15.	2,900
1292	Coleshill Gas Company	Warwick	" 22.	2,000
1296	London and Provincial Gas and Water-Works Company	London	" 22.	50,000
1303	Bahia Gas Company	London and Bahia	" 27.	100,000
1306	King's Cliffe Gaslight and Coke Company	Northamptonshire	July 2.	1,400
1307	Royston Gas Company	Hertford	" 2.	3,500
1312	Hay Water-Works Company	Brecon	" 5.	1,100
1318	Oswestry Gaslight and Coke Company	Salop	" 10.	10,000
1323	Winchcombe Gaslight and Coke Company	Gloucester	" 14.	1,500
1329	Fakenham Gas and Coke Company	Norfolk	" 25.	3,500
1332	Nelson Gas Company	Lancashire	" 27.	5,000
1333	Lydney Gaslight and Coke Company	Gloucester	" 27.	3,000
1352	Witham Gaslight and Coke Company	Essex	Aug. 14.	3,200
1369	Hartley Wintney Gas and Coke Company	Hants	" 27.	1,000
1399	Guiseley Water-Works Company	Yorkshire	Sept. 28.	2,500
1413	Whaley Bridge Gas Company	Derbyshire	Oct. 10.	2,000
1415	Hurstperpoint Gas Company	Sussex	" 16.	1,800
1427	Sowerby Bridge Gas Consumers Company	Yorkshire	Nov. 5.	10,000
1429	Storrington Gas Company	Sussex	" 7.	1,000
1460	*Farsley Gas Consumers Company*	Yorkshire	Dec. 3.	6,000
1469	Kinver Gas Company	Staffordshire	" 13.	2,000
1475	Redbourn Gas Company	Hertford	" 19.	1,100
1509	Milverton Gas and Coke Company	Somerset	1861—Jan. 18.	2,000
1513	United Kingdom Carburating Gas Company	London	" 21.	60,000
1517	Elland, West Vale, and Greetland Gas and Coke Company	Yorkshire	" 23.	6,000
1518	Llandovery Gas Company	Carmarthen	" 23.	2,000
1556	Heckington Gas Company	Lincolnshire	Feb. 26.	2,000
1597	Gefle Gas Company	Sweden and London	March 30.	15,000
1602	Blandford Gas and Coke Company	Dorset	April 8.	3,660
1638	Santiago Gas Company	Spain	" 29.	20,000
1674	Malta and Mediterranean Gas Company	Malta and London	May 29.	60,000
1687	Netherthong Gas Company	Yorkshire	June 4.	700
1694	Langport Gas Company	Somerset	" 11.	2,000
1695	Hessle Gaslight and Coke Company	Yorkshire	" 11.	1,500
1706	Buntingford Gas and Coke Company	Herts	" 19.	1,200
1717	Fazeley Gas Company	Stafford	July 3.	3,000
1719	Lymm Gas Company	Chester	" 3.	5,000
1724	Market Drayton Gaslight and Coke Company	Salop	" 8.	2,400
1748	Tweedmouth Water-Works Company	Northumberland	Aug. 1.	500
1774	Rowell Gaslight, Coke, and Coal Company	Northampton	" 29.	1,500
1785	Walker and St. Anthony's Gaslight Company	Northumberland	Sept. 5.	2,000
1806	Malvern Link Gas Company	Worcester	" 23.	5,000
1812	Aylesbury Gaslight and Coke Company	Bucks	Oct. 2.	10,800
1823	New Mill Gaslight Company	Yorkshire	" 11.	7,000
1843	Wivenhoe Gas Company	Essex	" 28.	2,000
1855	British Patent Charcoal and Gas Company	Not stated	Nov. 11.	10,000
1856	Tideswell Gaslight and Coke Company	Derby	" 11.	2,000
1858	Corsican and Mediterranean Gas Company	London and Corsica	" 12.	25,000
1891	Pontypridd Water-Works Company	Glamorgan	Dec. 9.	3,000
1892	Chertsey Gas Consumers Company	Surrey	" 11.	3,000
1894	Bridgnorth Gas Company	Salop	" 12.	5,000
1903	Pangbourne Gas and Coke Company	Berks	" 24.	1,500
1905	Dedham Gas, Coke, and Coal Company	Essex	" 27.	1,000
	IRELAND.			
52	Tullow Gas Company	Carlow	1859—Aug. 11.	2,000
56	Tullamore Gas Company	King's County	Oct. 8.	2,700
58	Saintfield Gas Company	Down	" 27.	1,000
59	Gorey Gas and Water Company	Wexford	Dec. 3.	2,000
64	Tuam Gas Company	Galway	1860—Jan. 24.	3,000
65	Clones Gas Company	Monagh	" 26.	2,000
68	Killarney Gas Company	Kerry	March 20.	3,000
72	Roscommon Gas Company	Roscommon	May 24.	2,500
75	Balbriggan Gas Company	Dublin	June 15.	1,400
76	Armagh Gaslight Company	Ulster	" 21.	3,000
85	Warrenpoint Gas Consumers and Water-Works Company	Down	Dec. 17.	3,000
87	Ballyshannon Gas Company	Donegal	1861—Jan. 18.	2,000
90	Mallow Gas Company	Cork	March 14.	4,000
91	Drogheda Gas Company	Meath and Louth	" 28.	8,904
95	Kinsale Gas Company	Cork	June 13.	2,000
101	Newry Water-Works Company	Donegal	Aug 23.	6,000
102	Dundrum Gas Company	Dublin	Sept. 17.	2,500
105	Donaghadee Gas Company	Down	Oct. 19.	2,000
	SCOTLAND.			
11	Aberlour Gaslight Company	Banff	1859—July 30.	650
2	Muirkirk Gaslight Company	Ayr	Aug. 4.	1,000
6	Lanark Gas Consumers Company	Lanark	1860—May 21.	3,500
	Ecclefechan Gas Company	Dumfries	July 11.	750
61	Denny Gas Consumers Company	Stirling	1861—March 7.	1,500
63	Rothesay Water Company	Bute	" 25.	7,000
75	Perth Gas Consumers Company	Perth	Sept. 18.	25,000
76	Meigle Gas Company	Perth	Dec. 2.	700
80	Bridge of Earn Water Company	Not stated	" 26.	45 0

Legal Intelligence.

COURT OF QUEEN'S BENCH.

MONDAY, APRIL 28.

(*Sittings in Banco, before Lord Chief Justice* COCKBURN, *and Justices* CROMPTON, BLACKBURN, *and* MELLOR.)

Ex parte THE MATLOCK BATH DISTRICT BOARD.

Mr. LUSH, Q.C., moved for a rule calling on the Secretary of State for the Home Department to show cause why a *mandamus* should not issue, commanding him to cause an advertisement to be inserted in the *London Gazette*, pursuant to the provisions of the Local Government Act, 1858, 21st and 22nd Vict., cap. 98. The Matlock Bath district is a portion of the parish of Matlock, having no defined boundary. A petition was adopted and presented, the necessary inquiry made, and notice given; and the order was made by the Secretary of State, the boundaries were settled, and a summoning officer appointed to carry out the Act, pursuant to section 16. The parish of Matlock having resolved to adopt the Act, a doubt arose, under the 14th section, and the Secretary of State was uncertain whether he ought to proceed any further. It was now contended that this district was now a place having a known and defined boundary, and that it might adopt the Act accordingly. Sections 12, 14, 16, 18, 19, and 20, were particularly referred to.

Justice BLACKBURN: The words at the end of the 14th section are against you. The Secretary of State may say, if he pleases, that the smaller place shall be excluded from the limits of the greater; but he has refused to do so. The 16th section is also adverse to your application.

Justice CROMPTON: It is a mere location of the sections. If the 14th had come after the 16th, there could have been no doubt about it.

Lord Chief Justice COCKBURN: I am of opinion there should be no rule. The terms of the 14th section are: "In cases where any place, hereby authorized to adopt this Act, includes within its limits any less place which, if it were not so included, would of itself be authorized to adopt this Act, such less place shall not be entitled to adopt this Act, unless the greater place within the limits of which it is included has refused to adopt the same; or unless it has been determined by one of Her Majesty's principal Secretaries of State, in manner hereinafter mentioned, that such place ought, as respects the adoption of this Act, to be excluded from the limits of such greater place." The district making the application would not be in a position to adopt the Act, without the permission of the Secretary of State. In the first place, the adoption of the Act can only be by a place of known bounds. Then come the provisions of the 16th section, referring to the adoption of the Act by places not having a known or defined boundary, and it is said that that section supersedes section 14; but I do not think it does. The difficulty only arises from the somewhat inartistic arrangement of the clauses; but, in truth, there is no real difficulty when they are read together.

Justice CROMPTON: I am of the same opinion. [His lordship referred to section 12, *et seq.*] If section 14 had been after section 16, there could be no possible doubt. The provisions of section 16 are only for the purpose of ascertaining if the place in question is fit to be put in the category of places with known and defined boundaries. I think the construction is clear, and there should be no rule.

Justices BLACKBURN and MELLOR concurred, and the rule was consequently refused.

Miscellaneous News.

THE WASTE PRODUCTS OF GAS-WORKS.

Dr. Lyon Playfair is delivering a short course of lectures at the Royal Institution, on the progress of some of the chemical arts since 1851, and in his first two lectures, on the 8th and 15th inst., his subject was "The Distillation of Coal." He selected that subject, he observed, not because there had been any marked improvement in the manufacture of gas, but on account of the new applications of the products of gas-works, which had given great value to what was formerly considered to be valueless. In the first lecture, he described the various processes of gas making, and explained the principle on which the illuminating power of gas depends. In endeavouring to illustrate the effect of enriching pure hydrogen gas by passing it through naphtha, the glass vessel in which the fluid was contained exploded when he applied a light to it, and fragments of glass were scattered in all directions, and dense brown fumes filled the lecture-room, and drove many of the ladies away. He exhibited a large and beautiful mass of paraffin, and a bundle of paraffin candles that had been made from coal-tar, and contrasted the present state of the manufacture and the use of that article with its condition in 1851, for in the Exhibition of that year, a single paraffin candle only was exhibited as a great curiosity which had been produced from peat; whilst in the Exhibition now open, there are abundant specimens of the paraffin wax and candles made from coal-tar, the production of that article having become an important branch of manufacture.

In the second lecture, the ammoniacal products, and the dyes produced from coal-tar were noticed. He stated that 4000 tons of the muriate, 5000 tons of the sulphate, and 2000 tons of the carbonate of ammonia are annually produced from gas liquor; and he no doubt surprised, and somewhat disgusted the lady-portion of his audience by informing them that their smelling bottles are filled from the refuse of gas-works, and the sweepings of streets. He exhibited the process of extracting oil and naphtha from coal, and proceeded to describe and to illustrate the chemical changes that take place in the formation of aniline, roseine, and the other hydrocarbon compounds that now form dyes of all colours. Specimens of all the products were exhibited, and of silks and woollens that had been dyed by them. To illustrate more forcibly the quantities of such products derived from coal, a mass of coal weighing 100 lbs. was placed near the lecture-table; and near to it were placed the various products obtained from a mass of that size, and the quantity of wool which had been dyed by the products of the distillation of a similar mass. The chemical processes by which coal becomes converted into beautiful colours, may, he said, also be applied to extract from the mineral the smell and flavour of almonds, with which confectionery is now flavoured, as a substitute for the far more dangerous dilutions of prussic acid. Dr. Lyon Playfair showed how easily silks may be dyed yellow, mauve, or magenta, by the application of the extracts from coal-tar; and, in expatiating on the great value of these new chemical processes, he observed that by their means this country had been rendered independent of foreign countries in the production of colouring substances, and that, in all probability, we should become the exporters of dyes, even to those parts of the world from which they have hitherto been imported.

THE POISONOUS EFFECTS OF CARBONIC OXIDE.

By H. LETHEBY, M.B, M.A., Ph. D., &c.

A good deal of misapprehension seems to prevail respecting the poisonous action of carbonic oxide. On the one hand, accidents have somewhat recently occurred, where, in all probability, the effects of the gas were entirely overlooked; and, on the other, fatal consequences have been unjustly attributed to it. Some of this confusion is due to the circumstance that our standard works on poisons and medical jurisprudence have either omitted the subject entirely, or have discussed it in very meagre language. The recent catastrophe at the Hartley Colliery, and the remarks which have been published respecting the supposed influence of the gas in causing the death of the men, have created an opportunity for a re-examination of this question.

Carbonic oxide was discovered by Priestley long before the close of the last century; and, in 1802, Clement and Desormes, at the instance of Goyton Morveau, undertook a careful examination of its properties. They not only proved its chemical nature, but they also ascertained that it was a poisonous gas. Birds put into it dropped dead before they could be taken out; and, when the experimenters themselves attempted to breathe it, they were attacked with giddiness and faintness. This experiment was repeated by Sir H. Davy, in 1810, who says that, when he took three inspirations of it, mixed with about one-fourth of common air, the effect was a temporary loss of sensation, which was succeeded by giddiness, sickness, acute pains in different parts of the body, and extreme debility; some days elapsed before he entirely recovered. It is, he says, fatal to animal life.

About the same time, the researches of Nysten demonstrated that the gas was capable of producing great disturbance of the system, when injected into the veins; and, although he concluded that the effects were of a mechanical nature, yet the accounts which he has given prove that the gas is a dangerous poison.

Later still, in 1814, the two assistants of Mr. Higgins, of Dublin, made experiments with it upon themselves; and, in one case—that of Mr. Wilter—with almost a fatal result. Having exhausted the lungs of air, he inhaled the pure gas three or four times, and was suddenly deprived of sense and volition: he fell upon the floor, and continued in a state of perfect insensibility, resembling apoplexy, and with a pulse nearly extinct. Various restorative means were employed, but without success, until they resorted to the use of oxygen, which was forced into his lungs, and then his life was restored; but he was affected with convulsive agitation for the rest of the day. He suffered, also, from violent headache, stupor, and a quick, irregular pulse. Even after mental recovery, he suffered from giddiness, blindness, nausea, alternate heats and chills, and irresistible sleep. The other gentleman, after inhaling the gas two or three times, was seized with giddiness, tremor, and incipient insensibility. These effects were followed by languor, weakness, and headache of some hours duration.

Since those experiments were made, others of a more extended character were instituted by Tourdes, and by Leblanc. Tourdes found that rabbits were killed in seven minutes when they were put into a mixture of one part of the gas with seven of atmospheric air. A fifteenth part of the gas in common air killed them in 23 minutes, and a thirtieth part in 37 minutes. Leblanc's experiments were made in conjunction with Dumas, and he ascertained that 1 per cent. of the gas in atmospheric air would kill a small dog in a minute and a half; and that birds were killed immediately in a mixture containing 5 per cent. of it.

Very recently, I have myself ascertained that air containing only 0·5 per cent. of the gas will kill small birds in about three minutes, and that a mixture containing 1 per cent. of the gas will kill in about half this time. An atmosphere having 2 per cent. of the gas will render a guinea-pig insensible in two minutes; and, in all these cases, the effects are the same. The animals show no sign of pain; they fall insensible, and either die at once, with a slight flutter—hardly amounting to convulsion—or they gradually sleep away, as if in profound coma. The post-mortem appearances are not very striking: the blood is a little redder than usual, the auricles are somewhat gorged with blood, and the brain is a little congested. In birds, there is nearly always effusion of blood in the brain; and it may be seen through the transparent calvaria by merely stripping off the scalp after death.

Accident has also demonstrated how injurious the gas is, even to the human subject. For many years past, attempts have been made to promote the use of water-gas as an agent of illumination. The gas sometimes contains as much as 34 per cent. of carbonic oxide. It is obtained by passing steam over red-hot charcoal; and, as the steam is decomposed by the ignited carbon, the hydrogen is set free, and carbonic oxide, with carbonic acid, is produced. Patents for this process of manufacturing gas date as far back as the year 1810; and they have, at various times, been put into operation in this country, and on the continent. Selligue, in 1840, obtained permission to use the gas in the towns of Dijon, Strasburg, Antwerp, and two of the faubourgs of Paris and Lyons. At Strasburg, an accident occurred, which put a stop to its use. The gas escaped from the pipes into a baker's shop, and was fatal to several persons; and, not long after, an aëronaut, named Delcourt, incautiously used the gas for inflating his balloon. He was made insensible in the car; and those who approached to render him assistance fainted and fell likewise. The use of the gas has, therefore, been interdicted on the continent.

Another source of danger from it is in the combustion of carbon. It is found in the neighbourhood of brick-kilns and furnaces. The

gases discharged from the latter contain it in large proportion. Iron furnaces produce it to the extent of from 25 to 32 per cent., and copper furnaces from 13 to 19 per cent. In the year 1846, M. Adrien Chenol was anxious to ascertain the properties of the gas yielded by his process of smelting zinc ores with carbon; and, not having a suitable instrument for collecting the gases, he attempted to draw them out of the furnace by means of a pipette. Some of the gas was thus inhaled, and he fell immediately, as if he had been stunned; the eyes were turned back in the orbits, the skin was discoloured, the veins were swollen, and presented a black tint under the skin; there were violent pains in the chest, and the brain felt powerfully oppressed. After removal to the open air, and the application of restoratives, sensibility gradually returned; but the internal pains were still severe, and there was a feeling of suffocation. For several days he felt oppressed and languid; the digestion was bad, sleep was obstinate and heavy, and it was frequently disturbed by cramps in the knees and toes. Even for months afterwards, there was a morbidly excited state of the nervous system.

In a more diluted condition, the gas is still able to exert an injurious action; and it is very probable that the singular catastrophe which happened at Clayton Moor, near Whitehaven, in the summer of 1857, was caused by the diffusion into the air of carbonic oxide, from the neighbouring iron furnaces. There is a row of cottages near to these furnaces, where, in the month of June, 1857, a number of persons were suddenly seized with insensibility, which soon passed, in some cases, into coma and death. About thirty persons were thus attacked, and six of them died. The effects were attributed at the time to the escape of sulphuretted hydrogen from the slag on which the cottages were built; but it is more probable they were caused by the oxide of carbon from the furnaces.

Lastly, it is worthy of remark that, very recently, Boussingault has noticed that the leaves of aquatic plants give off carbonic oxide and marsh-gas, when under the influence of solar light; and he asks whether this gas so produced may not be concerned in the unhealthiness of marsh districts?

A more complete acquaintance with the effects of this poison is a great desideratum, although enough is known to indicate its general mode of action, and to furnish evidence for its discovery.—*Lancet.*

EQUITABLE GAS LIGHT COMPANY.

The Half-Yearly Ordinary Meeting of the Shareholders of this Company was held at the office, John Street, Adelphi, on Tuesday, the 6th instant—J. Holdship, Esq., in the chair.

The Secretary (Mr. S. Andrews) read the advertisement convening the meeting, the minutes of the last general meeting, and the following report of the board of directors and statement of accounts:—

A statement of the accounts of the company for the half year ending the 31st of December last has been in the possession of the shareholders for several days past.

The re-sheeting of the two gasholders mentioned at the last meeting has been completed in a satisfactory manner. It has since been ascertained that two others are in an equally unsound condition. Your directors have, consequently, determined on having them re-sheeted during the summer.

Debenture bonds, amounting to £12,500, will fall due in the course of the current year, and your directors beg to announce their intention of providing for the payment of these bonds by making a further call of £3 each on the new shares, towards the end of the year, of which due notice will be given as usual.

At this meeting, two directors and one auditor will retire from office, in conformity with the company's Act of Incorporation; the directors who retire by rotation are George Henry Pinckard, Esq., and Augustin King George, Esq., and John Stroud, Esq., auditor; and, being eligible, they offer themselves for re-election.

A net profit of £17,330. 16s. 7d. (including £3163. 5s. on sale of new shares) has been realized during the last half year, which, with the balance of the unappropriated profit of the previous half year of £74. 7s. 9d., makes £17,405. 4s. 4d. available for dividend, from which your directors recommend a dividend of 50s. per share on the old shares, and 6s. 5d. per share on the new shares; and a further dividend of 30s. per share towards the arrears of dividend on the old shares for the half year ending the 31st of December, 1855. The said payments to be less the income-tax, which will be deducted accordingly.

Dr. *Manufactory and Revenue Account, for the Half Year ending December* 31, 1861. *Cr.*

To Tradesmen's accounts, purification, &c.	£	585	6	0	By Gas-rates, to Dec. 31, 1861	£32,914	5	4
Coals, carbonized		13,497	12	7	Meter-rental	760	17	10
Wages (manufacture only)		3,272	6	9	Coke, net sales and stock	5,123	1	0
Rent, rates, and taxes		589	5	9	Breeze, ditto	176	15	7
Directors fees		500	0	0	Tar, ditto	837	1	11
Auditors ditto		30	0	0	Ammoniacal liquor	298	0	3
Salaries		1,368	10	6	Profit on sale of 437 new shares	3,163	5	0
Collector's commission		310	11	9				
Stationery and stamps		91	3	10				
General charges		204	18	2				
Bad debts and allowances		136	4	0				
Wear and tear		4,190	0	11				
Interest on debentures		1,085	1	0				
General law charges		46	3	6				
Income and property-tax		35	5	7				
Net profits, to Dec. 31, 1861		17,330	16	7				
	£	43,273	6	11		£43,273	6	11

Dr. *Balance-Sheet.* *Cr.*

To Capital, joint-stock	£	240,000	0	0	By Investment—amount to June 30, 1861	£256,064	10	6
Debentures		40,400	0	0	Less mains taken up	41	16	3
Debenture interest		249	10	10		£256,022	14	3
Dividends		365	2	3	Charged this half year	1,140	3	5
Tradesmen's accounts, &c.		4,953	2	9		£257,162	17	8
Taxes, rates, &c.		175	4	3	Meters	6,391	0	11
Collector's commission		152	16	7	London and Westminster Bank "deposit"	7,150	15	9
Auditors		30	0	0	Gas-rates	20,674	1	7
Profit and loss		17,405	4	4	Cash balance	2,691	3	9
					Trademen's accounts for coke, &c.	1,925	9	3
					Coals, stock	4,326	8	2
					Coke, ditto	240	0	0
					Breeze, ditto	100	1	0
					Tar, ditto	38	6	8
					Ammoniacal liquor, ditto	17	2	0
					Service-pipes, ditto	220	12	11
					Main-pipes, &c., ditto	677	3	5
					General stores, ditto	2,012	6	1
					Income and property-tax	103	11	10
	£	303,731	1	0		£303,731	1	9
To Unappropriated profits, to June 30, 1861	£	74	7	9				
Net profit to Dec. 31, 1861		17,330	16	7				
Amount available for dividend	£	17,405	4	4				

Examined and audited the foregoing accounts, and found the same correct.

(Signed) George Dyer, J. M. Holdship, John Stroud. } *Auditors.*

The Chairman said: Every gentleman has had a copy of the accounts sent to him, and has had, therefore, an opportunity of inspecting them. We may therefore take them as read. I will not detain you above a minute or two, as the directors have nothing very new to communicate beyond what is stated in the report. I will draw your attention to only one item. You will observe that £3163. 5s. is the profit on the sale of new shares. I bring that forward in order to inform persons here and in the country that they will not see that item again. You will observe that two of the gasholders require re-sheeting, but the expense will not amount to very much. The directors think that the works should be put into an efficient state. At the same time, you are not to suppose from that remark that they are not at present in a very excellent state. The engineer will be glad to see you at any time, and, if you go, you will have an opportunity of seeing the high state of efficiency in which the works are. We have debentures to be paid this year of £12,500, and we shall make a call in order to pay these debentures; but, I may inform you that we do not require any further sum than that. I have nothing further to bring under your notice, but any questions you may be pleased to ask I shall be happy to answer to the best of my ability.

A Proprietor: Will you make the same amount of call as last year?

The Chairman: No; we have, as I stated, debentures to pay, amounting to £12,500, and the call we make will be sufficient to pay them off. I beg to move—"That the report and statement of accounts be adopted."

Mr. Rhodes: seconded the motion.

Mr. Grattan: You recommend a dividend of £2. 10s. on each £50 share, minus the income-tax?

The Chairman: Yes; and I will tell you why we do that on the present occasion. We have not paid the income-tax on the profits, but it is requisite at present that that should be done, and, therefore, we have deemed it desirable to deduct it from the dividend.

Dr. Liddell: I thank the directors for having published the balance-sheet. I do not know why they have not published their report at the same time with the balance-sheet; but, of course, if there is any objection, that should not be done. I should suggest, however, that, if possible, the report and balance-sheet should be issued at one and the same time. Your capital, I see, is about £280,000?

The Chairman: Yes, including the debentures.

Dr. Liddell: Your rental would give £70,000?

The Chairman: No; about £67,000.

Dr. Liddell: Rather less than a quarter of the capital?

The Chairman: That would be so.

Mr. Russell: Several persons express concern as to the new oil. Has it occupied the attention of the directors?

The Chairman: Undoubtedly it has.

Mr. Wheeler: Some say they will stand a chance of having their houses blown up.

Mr. Russell: However that may be, I am sure every one will be extremely gratified to receive such a favourable report as that issued by the directors.

Mr. Rhodes: Respecting this oil, all sorts of strange feelings prevail as to what will happen to London; but I have no doubt the directors are quite awake to the subject.

Dr. Liddell: I find that the illuminating power of your gas is 20 per cent. above what you are compelled to give by the Act of Parliament. The public, I am sure, must be highly satisfied with the illuminating power you give them. I have lately had to examine the gas of four different companies.

The average of some of them is above that of others, but I think your gas is, perhaps, the highest. It is 15 candles.

The SECRETARY: Upwards of 15 candles.

The CHAIRMAN: We scarcely know what a complaint is. I believe we may truly say that we have given the utmost satisfaction.

Dr. LIDDELL: I presume you have your testing-room open, and that you afford full opportunity for the testing man to go at all times—therefore, your gas is always of the same quality?

The CHAIRMAN: That is so. Has any gentleman any further remark to make?

Mr. JOHN BOX: I have only one remark, sir. There was an objection made last time about the report not being sent round. I believe the same objection still exists; but we may as well, perhaps, go on as at present until the directors see fit to make a change. The Act of Parliament allows us to go on until we clear off all incumbrances, and, after that, the directors are at liberty to proceed as they think proper.

The CHAIRMAN: We are behaving as liberally as we can. We still want £6000 to make up the dividend of 1855 to 10 per cent.

Mr. BOX: Two and a half per cent. was what you paid in December, 1855.

The motion of the chairman—"That the report and statement of accounts be received and adopted," was here put, and unanimously agreed to.

Mr. RUSSELL moved, the dividend recommended in the report.

Mr. RHODES seconded the motion, which was adopted.

Mr. RUSSELL moved—"That Mr. Pinckard be re-elected a director of the company."

Mr. RHODES seconded the motion, which was carried *nem. con.*

Mr. GRATTAN proposed, and Mr. RHODES seconded, the re-election of Mr. Augustin King George, which was adopted.

Mr. PINCKARD: I thank you for the kindness you have manifested in re-electing me, and for the confidence you repose in me. I have been a director here for twelve years, and, during that time, I am happy to say that progress has been made. I do not take to myself any credit for that progress, but I entertain a confident hope that we shall be able to maintain the company in its present very satisfactory condition.

The retiring auditor, Mr. Stroud, was re-elected.

Mr. RHODES: I brought forward a motion, six months ago, respecting a greater allowance being made to our auditors. They are the best friends we can have. In those companies which have not gone on well, the cause has been the want of auditors. Here we have had auditors who have been with us for many years. We have, indeed, attended here many times when we received no dividends, but that was not the fault of the auditors. Still, we had no complaining—no changing under the circumstances. Some companies have had the uprightness and honour, in such cases, to discontinue their salaries; but that has never been required amongst us. This company has had to travel through deep waters—so much so, that many shareholders have often asked me if we were ever to receive any dividends? But now, I am happy to say, the company has turned round, and is improving. In fact, the Equitable Company is the wonder of many companies, to think that it has raised up its head. I have met some gentlemen to-day, who have asked me in what manner they could obtain shares in it? They inquired if I could dispose of a few shares to them, in order that they might come in and join us; but, of course, I answered in the negative, because I only purchased my shares with the view of investing, and not of speculating. Well, now, I am of opinion that our servants ought to partake of something of that prosperity which we have been fortunate enough to realize ourselves. That was the view I took at the last half-yearly meeting, when I proposed an increase to the salaries of the auditors. I then proposed, and I propose now again—"That the allowance to the auditors be increased from £60 to £90 per annum, such increase to commence from the 1st of July, 1861."

Dr. LIDDELL: I opposed that motion on the last occasion, because of notice not being given of it, but now that ample notice has been given, I have much pleasure in seconding it. I am one of those who think that no alteration in salaries should be made, unless proper notice was in the first instance given. Indeed, there is some clause in the Act of Parliament which obliges some such notice to be given. If I mistake not, one of the clauses of the Gas Companies Act, distinctly states that you cannot bring forward questions of the kind without notice. But then it is said in another Act, "unless on ordinary business." As I am not a lawyer, I cannot take upon myself to say whether an increase of the salaries of the auditors was an alteration which had reference only to "ordinary business," but I apprehend not, and, therefore, I hold that we have no power to alter any salaries without due and proper notice being given. I think the view of the law should be drawn by the directors, and that it ought to be submitted to by the shareholders, unless good cause to the contrary be shown. However, I have much pleasure now in seconding the motion.

The motion was then put and carried.

Mr. RHODES: I am glad to find that a little addition has been made to the salaries of the auditors, but I am for extending that principle, and increasing the remuneration to our servants generally. I should be pleased to find that every officer you employ should share to some extent in your prosperity. I think, if it could be found right to do so, that we should allow our officers to have their salaries clear of income-tax. That would be a judicious alteration in my judgment, and I throw it out in the hope that it will meet with consideration from the board.

The CHAIRMAN: As you leave it to the board, I can only say that we shall consider it. You are aware that we allow all our servants 10 per cent. at the end of the year.

Sir J. DUKE: I may just add that it is the general feeling of the board, that while we are most happy to give you such a large dividend, we should consider the claims which the officers of the establishment have upon our generosity.

Mr. TODMORDEN moved a vote of thanks to the directors, for their ability and attention to the interests of the shareholders.

Mr. J. BOX seconded the motion, which was unanimously adopted.

The CHAIRMAN: It is very gratifying to us to receive this expression of your thanks. It will encourage us to do that which we have always hitherto attempted to do—the best in our power.

A vote of thanks was then passed to the auditors, and the proceedings terminated.

WESTERN GAS COMPANY.

An Extraordinary General Meeting of the Proprietors of this Company was held on Thursday, May 8, at the offices of the Company, Argyll Street, Regent Street—F. W. RUSSELL, Esq., M.P., in the chair.

The SECRETARY (Mr. Barber) read the notice convening the meeting, and the seal of the company was affixed to the register of proprietors.

The following report was read:—

The directors submit to the meeting the audited statements of account, showing the result of the company's working for the half year ended 31st December last.

Owing to circumstances over which the directors have no control, and which affected the gas companies generally during the past half year, the rental, compared with that of the corresponding half of the previous year, does not exhibit so large an increase as usual. Nevertheless, the working was somewhat more favourable, and the profits, therefore, allow of a dividend at the rate of £9 per cent. per annum on the share capital, including the amount (£10,000) of the second call on the new B Shares.

After payment of all charges, and of £1200. 8s. 3d. for interest, the balance to the credit of profit and loss, including £211. 4s. 11d. brought forward from the last account, amounts to £10,868. 8s. 7d.

The directors recommend that a dividend, free of income-tax, be declared of 9s. per A share (£10 paid), and 1s. 10d. per new B share (£2 paid at date of the accounts), leaving a surplus of £579. 17s. 9d.

Mr. BOX: Is it usual in this company that the minutes of the last meeting should be read? It is so in other companies.

The CHAIRMAN: We have not been in the habit of doing so; but, if the shareholders at large wish it, we shall readily comply with it.

Mr. ATKINSON: I presume you were here the last time.

Mr. BOX: That is the very reason why I wish them to be read.

Mr. RHODES: Perhaps Mr. Box will allow me to remind him that this is an extraordinary and not an ordinary meeting.

Mr. BOX: I move that the minutes of the previous meeting be read.

Mr. STEEL: I beg to second that.

The resolution was put and lost by a large majority.

The CHAIRMAN: The minutes are on the table, and any gentleman who wishes to read them will have an opportunity of doing so.

The SECRETARY then read the revenue statement, showing a balance of undivided profits amounting to £10,868. 8s. 7.

Mr. WAUGH: Has the value of our products, other than gas, much increased in consequence of the large demand for the new colours?

The CHAIRMAN: I will answer that presently, if you will allow me.

Mr. WAUGH: Certainly.

The CHAIRMAN: Gentlemen, I am very happy to say that I shall not trespass much upon your time to-day. I have very great satisfaction in stating to you that the affairs of this company are proceeding in a manner perfectly satisfactory to us; and I think, taking into account the very peculiar circumstances of the half year, we may congratulate ourselves upon our success. The past half year is one in which God in his providence has been good enough to favour us with a remarkably clear and blue sky; and it has been a period during which, comparatively speaking, artificial light has been but little employed. We have great reason to be grateful, as men, though perhaps not so as shareholders. We have, however, to regret that the unfortunate state of the trade of the country has, in itself, made economy imperative on all parties; and the great check which has been given to commercial prosperity has had a very serious effect upon all gas companies. In fact, persons have burned as little gas as they possibly could, and that has prevented our proceeding as rapidly as we otherwise should have done. But we have this satisfaction, that we have tested the position of this company in the most searching manner. In spite of all these causes, we still show an increase of revenue. There is another matter which we have no control over, and that is the growing disposition to curtail the hours of business and close establishments much earlier. On one of our best days in the week—Saturday—these places of business are closed much earlier. All these causes have been most unfavourable to us, still we show a steady progress, and I have no doubt we shall continue to do so, as our great district becomes covered with the largest and finest houses in London, and that you will find your investment in this company a profitable one. Now I may tell Mr. Waugh that, had it not been for an increase in the price of products, there would no doubt have been a decrease in our revenue. I beg to move: "That the report and accounts be received and adopted."

The motion was seconded.

Mr. BOX: I have gone through these accounts, examined them, tested them, and I am much pleased to tell the meeting that, notwithstanding the drawbacks to which the chairman has referred, your profits have not been reduced. Now, what is the precise financial condition of this company? You have increased the consumption of coal, 99 tons this half year; you have increased in your rental, £1003 this half year; and the question is, whether this increase of rental is in proportion to the increased consumption of coal? I answer, it is more than that. I take 100 tons in the two half years, and the increase on the per centage of coals used is £5·88—nearly £5. 18s. per 100 tons increase over last half year. The coals used are 12,565 tons, and that gives you a total increase in your rental, leaving out residual products, of £756. 9s. But the grand thing with all gas companies is, to pay attention to the unaccounted-for gas. If you want to compete with the economies of the times, you must pay attention to your little *et cæteras*. When I first went into this company, the leakage was 12 per cent.—it is now under 7; and I think we shall be able to reduce that further. I think the report is a truthful one, and I heartily sanction the recommendation of it.

Mr. SMITH: I see an item of £1200 charged for interest. What is the amount of our debt?

The CHAIRMAN: Fifty thousand pounds.

Mr. SMITH: Is it in contemplation to liquidate this debt?

The CHAIRMAN: We have raised money under our borrowing powers, and we pay interest varying from 4½ to 5 per cent., which is a better operation for the company than if we were to make calls upon the B shares.

Mr. BESLEY: I understand that some A shares were issued to trustees, who have no power to take up new capital; and, therefore, if you diminish the dividend on the A shares, you, to a certain extent, damnify those persons, without, in any degree, improving our position.

The CHAIRMAN: When we have arrived at our maximum dividend, we may then consider the question of paying off our debt.

Mr. ATKINSON: I should like to know whether it is intended to do anything in the way of paying a tribute of respect to our chairman. The question was mooted some two or three years ago, and I think it ought not to be dropped.

The CHAIRMAN: I can only say that I think this is not the time to vote away your money.

Mr. ATKINSON: We might give it out of our own pockets.

The CHAIRMAN: As long as I enjoy your favour, I shall be perfectly satisfied and grateful.

The resolution for the adoption of the report and accounts then passed unanimously.

Mr. Box moved, and Mr. RHODES seconded, a motion for the payment of a dividend, free of income-tax, for the half year, of 9s. per A share, and 1s. 10d. per new B share, which passed unanimously.

Mr. BRICKWELL moved, and Mr. Box seconded, a vote of thanks to the chairman, which passed unanimously, and was suitably acknowledged.

METROPOLIS GAS SUPPLY.

CITY COURT OF SEWERS, GUILDHALL, TUESDAY, MAY 6.

A Meeting of the Commissioners of Sewers was held this day—Mr. DE JERSEY, in the chair.

Mr. DAW (the chief clerk) read the following letter from the Great Central Gas Company, in reference to the police reports of lamps not properly lighted:—

Sir,—In reply to your request for an explanation as to the lights going out from the 14th to the 28th ult., I beg to say that 23 out of the 26 cases reported, were caused by some defect in the carburators. The case in Angel Alley is not in this company's district, and the two in Swan Lane and Warwick Square were caused by water in the service-pipe. (Signed) R. M. MASSEY, Sec.

Dr. ABRAHAM inquired what had been done in reference to that communication.

Mr. DAW said, that he had only received it that morning, and had done nothing with it. He had also received a letter on the same subject, from Mr. Matthew Finch, of Little Somerset Street, in which he stated that, having made complaints to the Great Central Gas Company, they directed him to apply to the Commissioners of Sewers, in reference to the explosion of one of the carburetting boxes attached to a lamp in front of his premises, which, but for the fact that his attention was promptly directed to the circumstance, might have resulted in serious consequences. It appeared from the letter that, during the night of the 28th of April, the writer's attention was called by his son to the condition of a lamp affixed to the wall of his premises, when it was found that fire was issuing from the red box on the lamp. He immediately got a ladder and tools, but, before he could reach the spot, the box burst, a flame 3 feet high issued from the top of the lamp, and the liquid fire dropped on the pavement. Considering that the recurrence of such an accident would be dangerous to the public, he thought it right to bring it under the notice of the commissioners.

In answer to a question by Mr. MURRELL, it was stated that Mr. Finch was a plumber and glazier.

Deputy HARRISON said, he thought both of these letters should be referred to the Carburating Company. It was a matter of the greatest importance, and the commissioners should have an explanation. They were not about to dispense with the carburetting process because of an explosion or two, for, if that principle were adopted, they might perhaps be without light altogether, seeing that there had been many explosions of gas. He would move—"That copies of the letters be sent to the Carburating Company, with a request that they would give such explanation in reference to the matter as they might think fit at the next court."

Deputy WHITESIDE seconded the motion.

Deputy CORK said, he would not enter into the merits or demerits of the carburetting process, but he would just state that he had heard many complaints respecting it.

Mr. H. L. TAYLOR said, the Carburating Company ought to be required to attend before the commissioners at their next meeting.

The motion was then put and carried.

Mr. HAYWOOD (the engineer) said, he had also received a letter on the same subject. This one was of special importance, but he had received many others. It was from the Great Central Gas Company, and addressed to himself:—

Dear Sir,—For several days past, the Carburating Company's men, have been fixing their apparatus to the column-lamps several streets apart, picking out a lamp here and there, requiring but little alterations in the fittings. By these means, our men are prevented following to see that the work is properly done at the time, the Carburating Company never having yet given us information where they intend to do their work. The directors beg to protest against this order of proceeding as being contrary to the original agreement, and must refuse to allow its continuance. Yesterday their men were fixing a naphtha-box to a lamp in Queenhithe, which they exploded, nearly destroying the lantern: the remnants I send for your inspection. This, as you will be aware, is the third accident that has occurred within the last three weeks.

I am desired by the directors again to call your most serious attention to the case of explosion in the bracket-lamp in Harrow Alley. Had one of the numerous lamps fixed on the rear of the same premises ignited, instead of this lamp, the great probability is that occurring as it did late in the night, the whole block of houses and buildings used as cattle-sheds would have been burned down. The owner of the property has made a communication to the board, drawing their attention to the risk which is incurred, and expressing great fear and anxiety for the future. I am desired by the board of directors to call your attention to these cases, and to the damage arising therefrom; as, in case of accident and damage, the Commissioners of Sewers will be liable for the results. (Signed) R. M. MASSEY.

Dr. ABRAHAM said the commissioners must deal with this letter in the same way that they had dealt with the two previous ones, and send a copy of it to the Carburating Company. It was a very important communication, and no legal opinion was required to decide as to their liability in the matter. The Carburating Company, of course, were liable for any neglect of duty in carrying out the process, and they ought to be called upon for an explanation of the circumstances to which their attention had been directed. He concurred in the views and opinion expressed by Deputy Harrison, that they were not to be scared and frightened because of a few accidents occurring on the introduction of a new system. No doubt, many members of the court would recollect that accidents from gas explosions were as common as daylight, and of the most fearful and fatal character. It would, he considered, have been a very extraordinary thing indeed, had a process of this kind been introduced to so large an extent without a few accidents occurring. He could hardly conceive it to be possible; and, therefore, this formed no sort of objection to the carburetting process for augmenting the illuminating power of the gas; it only showed that there had been a want of care on the part of those who had the management. There could be no doubt that the Carburating Company had undertaken a larger amount of work than they had been able to attend to in a proper and efficient manner; but this was a matter that would right itself, and he hoped the committee would not get at all dispirited or discouraged by a few accidents occurring in the introduction of the carburetting process. He felt confident that by and bye this process would become general, and an immense amount would be thereby saved to the ratepayers of the metropolis. The mode in which this company adopted it might be imperfect, or that the machinery they employed required a great deal of improvement. As accidents occurred, improvements would be suggested, and, in time, there would be such a mode of applying the process as would render it as free from liability to accident as anything else. He moved—"That a copy of the letter be sent to the Carburating Company."

Mr. H. L. TAYLOR said there was one point which both Dr. Abraham and Deputy Harrison had lost sight of. They had dwelt upon the accidents arising from the bursting of carburetting boxes; but that certainly was not the main point—it might be the least. The Great Central Gas Company had had complaints made to them that twenty-six public lamps were out, or gave but little light; and, as an explanation, they attributed twenty-three to defects in the carburetting process. Now, this was a serious matter, and, moreover, it did not arise entirely upon the representations of the Great Central Company. The subject came before the commissioners individually from time to time, and complaints were being made by their constituents. Some parties in his ward had called on him, and pointed out the deficiency of light in the public lamps, upon which the carburators had been placed. There was a great saving of expense to the ratepayers by using this process; but to him it appeared clear that the saving of light was enormous. (Laughter.) In fact, some of them could not be seen at all. Well, if this were so, the system had evidently failed, because it had been held out that they were to have the same amount of illuminating power at a cheaper rate; but, if they were only saving so much money per annum, and getting little or no light, it was a practical failure. He would like to see some improvement upon the present system of lighting London; and, if the advantages which had been held out by the Carburating Company had been realized, and they had obtained the same amount of light by passing the gas through naphtha at a less cost, he would have been delighted; and, even if there had occurred an accident such as had been described, they might hope that a remedy would be found so as to avoid any danger for the future. He believed there was very great cause to complain of the lights on the part of the citizens who were obliged to be out late at night. He was not often out late, but recently he had been out later than usual, and he was bound to state that those lamps which had the carburetting boxes attached to them appeared to throw a considerable shadow underneath, while at the same time the light from the burners was of the smallest character. He had compared the light of these lamps with that of the lamps to which the carburetting process had not been applied, and he could state, from his own observation, that the latter gave double the amount of light that the former did. That being so, he could arrive at no other conclusion than that the carburetting process was a failure, inasmuch as though there was a saving of the amount of gas passed through the burner, and therefore a smaller consumption, there was an evident deficiency of light. They could not have too much light in the streets of London; let the gas give as much light as it would, and he was assured there would never be complaints on that head. He wished the Carburating Company were before the commissioners that day, so that it would not be necessary to lose a week in applying a remedy to the present serious state of circumstances.

Mr. C. YOUNG said he had observed the lamps in Warwick Square, where he lived, and found that those to which the carburetting process was applied threw a stream of light on the parapets of the houses, but none upon the ground.

Mr. SANDERS said his impression was, that there were three reasons why the lights were defective. In the first place, the carburetting boxes were of too large a size. At the West End of London, in Bird Cage Walk, where the process had been adopted, the boxes were much smaller. The next reason was, that the lanterns in the City were badly kept, and were certainly in the most dirty and filthy condition possible. Then, again, on account of the height of the carburetting boxes, the light from the burner was thrown more upon the frame of the lantern than upon the glass, and the consequence was a diminished light from these three causes. He did not suggest what were the reasons, because no doubt the gas companies would say it was ridiculous; but, the fact was, that in his office, between 2 and 3 o'clock in the morning, the light from the gas was very much less than what it was earlier in the night; indeed it was reduced to a small yellow flame. He did not intend to say what the gas companies did, whether the pressure was less or the quality of the gas less, he was only giving a broad fact. Passing through the City, sometimes, at a late hour, he noticed the street-lamps, and was quite prepared to endorse the statement that had been made, that the light from them was exceedingly bad.

Deputy HARRISON said it was evident, from the observations they had heard, that it was very desirable no time should be lost in having a thorough inquiry on this matter. The two previous letters had been referred to the Carburating Company, and the present motion was, that a copy of the Great Central Gas Company's letter be sent to them for their information, and to give explanations in reference to the circumstances alluded to therein. Those statements should be taken with some degree of discount, for it was easy for the gas company to write and tell them that a certain explosion had taken place, and then to fill up a page of their letter with reflections as to what might have happened if the explosion had occurred somewhere else. The letter showed that there was no great love between the companies, but with that the commissioners had nothing to do. They had to look to the public interests, and therefore he would suggest to Dr. Abraham that the three documents which had been brought before the court that morning should be referred to the General Purposes Committee, so that they might have a careful report on the subject by that day week.

Dr. ABRAHAM concurred in the suggestion, and amended the motion accordingly, which, after some further conversation, was put and agreed to.

Deputy LOTT, in accordance with notice, moved the following resolution:—"That it be referred to the engineer and the medical officer of health to examine and report to this court whether the light from the gas-lamps in the public streets is increased or diminished by the carburetting process, and whether the light thrown upon the footways is not obscured by the shadow created by the tin boxes containing the material for the carburetting process?" He said, the remarks which he had intended to make were anticipated in the conversation which had taken place upon the letters that had been read. He was one of those so much attached to scientific progress, that he would be the very last to interpose any obstacle in the way of improvements of any kind; but he really felt that the mode and manner in which the carburetting process had been attempted to be carried out were most objectionable. He thought they would all agree that the tin canisters attached to the lamps were most unsightly, and, at a glance, it was evident that they must cause a shadow; but there would be little difficulty in placing those vessels within the gas column, or some other place where they could not be seen. The main question, however, was, whether the carburetting process did produce any additional light? Gentlemen were present from his ward, who had come for the purpose of stating to the committee that, so far from these lamps giving additional light, it was the very reverse—the light was diminished. Seeing that the subject had been already gone into pretty fully, and seeing, also, that it was to be referred to the General Purposes Committee to examine and report, he would not occupy the time of the commissioners by calling these gentlemen, unless it were desired.

The CHAIRMAN said, he would suggest to the honourable member to alter

his motion, so as to make the reference to the committee, who would have the medical officer and engineer before them. He thought it would not be expedient to hear statements from the gentlemen present on this subject, as it would tend rather to a prejudging of the matter.

Deputy WHITESIDE seconded the motion.

Mr. MURRELL said, some remarks had been made in reference to the illuminating power of the other lamps. He himself observed a great diminution of light in them, and he was borne out in this statement by his neighbours, who had called his attention to the subject. He recommended that the following words should be added to the resolution :—"And to consider, also, the illuminating power of the other lamps."

Deputy LOTT consented to the alterations suggested by the chairman and the last speaker.

Dr. ABRAHAM said, he was, unfortunately, obliged to be out late at night very frequently. Five or six times during the last month he had observed a great difference in the light of the public lamps. Not only in those to which the carburetting process was applied, but also in the other lamps, there was a great diminution in the light, about two or three o'clock in the morning. He would venture to say that, if his friend would take a circuit of the City and of the other parts of the metropolis at that time in the morning, he would find that it was the case very nearly everywhere. Whether the gas companies did diminish the quality or quantity of the gas supplied earlier in the morning, he could not tell; but he was confident, from his own observation, that the lights at that time, nearly all over London, got more and more dim. In reference to the carburetting process he remarked that, when the experiments were being tried in Moorgate Street, he repeatedly noticed the lamps, and observed that those to which the carburators were applied burned as brilliantly, with a consumption of 2 or 3 feet an hour, as those on the opposite side of the street, burning 5 feet per hour. If the process answered in Moorgate Street, why not elsewhere? There must be something with which the commissioners were not acquainted, to account for it. As two companies were fighting against, and very jealous of, each other, the commissioners must be cautious in pronouncing a judgment on the subject. He believed it would, on inquiry, be found that there were faults on both sides; and of this he was perfectly confident, that, about two o'clock in the morning, all over London, whether the carburetting process were adopted or not, there was a great diminution in the illuminating power of the gas supplied. It was important that the commissioners should not let it go abroad that the carburetting process—which as yet had not had a fair trial—was useless, simply because there was this diminution in the light afforded by the public lamps.

The motion was then put, and carried.

TUESDAY, MAY 13.

At the meeting of the commissioners held on this day—Mr. DE JERSEY in the chair,

Mr. DAW (chief clerk) read a letter from the Great Central Gas Company, stating that of the total number of lamps complained of as being out, during the previous week, 15 were attributable to defects in the application of the carburetting process.

A letter was also read from the Carburating Company, to the following effect.—

To the Honourable the Commissioners of Sewers of the City of London.

Gentlemen,—The letter of the secretary of the Great Central Gas Company, having been laid at the last court before your honourable commission, was published in the newspapers, and contains many false and injurious assertions, which we have not had the opportunity of contradicting. We beg, therefore, that your honourable commission will give publicity to our reply read before your honourable court on Friday last, the 9th inst., that the public may have both sides of the question before them.

Touching the efficiency of the light in the public lamps, we beg to recommend your honourable court to appoint some competent person to examine and report upon the evening pressure supplied in various parts of the district within our contract, as from examination we find you are receiving much less than the 3 feet per hour contracted to be given by the gas company in a large number of the lamps supplied with our process.—I have the honour, &c.,

(signed) R. KIDD, for the United Kingdom Carburating Gas Company.

The two communications were, on the suggestion of the chairman, referred to the General Purposes Committee.

ST. OLAVE'S DISTRICT BOARD OF WORKS, TUESDAY, MAY 6.

At a Meeting of the Board held this day, a letter was read from the Surrey Consumers Gas Company, in reference to their proposal to light, extinguish, &c., the public lamps in the district at £4. 15s. per lamp per annum, stating that they would not make any alteration in the terms of their proposal, thus precluding the board from lighting and extinguishing the lamps.

Mr. WALKER urged the board to resist the efforts made by the company to force them to accept their terms. The South Metropolitan formerly supplied the gas at £4, and then, when there was a healthy competition, the present company reduced it to £3. 15s. In 1860, the Phœnix and South Metropolitan Companies reduced their prices, but the Surrey Consumers did not. He would urge the board not to surrender the right to clean, light, and extinguish their own lamps, and this they could do still if the lamps were supplied by meters. As to meters, a gentleman had written to him, that many towns burned by meter, and the result in Worthing was, one meter to 39 lamps, much less gas being burned than was formerly charged per hour. The effect had been always beneficial, reduced prices being charged to the public. He considered its adoption in St. Olave's would reduce the charge from £4 to £2. 10s. 8d. per lamp. He moved—"That the course adopted by the Surrey Consumers Gas Company was considered by the board as unjustifiable, and evidently intended to compel the board to abandon their present system of lighting, extinguishing, and cleansing the public lamps in the district; that the board resolve to resist, to the utmost, the injustice that the monopoly of the company enables them to inflict; that a committee be appointed to consider as to the propriety of supplying gas to the public lamps by meter, with power to call in a gas-engineer, if necessary, to aid them in their consultations; and that the clerk be empowered to enter into negotiations with the company as to the price they would charge per 1000 cubic feet for gas supplied to the public lamps."

Mr. GROSE seconded the motion.

Mr. SHAND had formerly advocated bringing the company into the district to bring down the price of gas; but, since then, they had put themselves in antagonism to the ratepayers. The company were paid most liberally, and the present system adopted by the board had been found to answer. He was surprised at the conduct of the company, and so would support the motion. By lighting by meter, 18,000 feet of gas per lamp would not be burned, as was calculated now. He would make a bold stand on this matter, and, rather than submit, he would have the lamps supplied by some other material.

Mr. CAMERON said the company had been abandoned by the consumers themselves, for 4000 of them had pledged themselves to burn the gas, but they had not done so. They might have had the management in their own hands, but, as they refused to do so, the company now said they would overcharge for the gas. He was, however, in favour of the motion.

The resolution was put and carried; and Messrs. Walker, Greenwood, Shand, Grose, Courage, Brander, and Dr. Barron, were appointed as the committee.

Mr. WALKER pointed out that, in conformity with the provisions of the Gas Act, the gas company was bound to lodge at the office of the clerk of the peace, a map of all their gas-mains; and he moved—"That the surveyor ascertain if the map had been deposited, and if so that he copy so much of it as related to the district." He then, in conclusion, read the following extracts from a letter he had received upon the subject of burning gas by meter :—"The towns which now burn their public lamps by meter are St. Ives, Lincoln, Leicester, St. Neots, Torquay, Worthing, and several other towns." "The price for gas supplied to the public lamps at Worthing has been fixed at three-fourths of that paid by the private consumer; the quantity of gas consumed is ascertained by one meter to every 39 lamps, and the company provides the meters; and the quantity of gas consumed is about $2\frac{3}{4}$ feet an hour instead of 5 feet as formerly charged." "In Reading, the companies (there being two) have undertaken to supply the public lamps by meter at 3s. 7d. per 1000 feet, while the lowest price paid by the private consumer is 5s., the consumption to be ascertained by one meter to every 12 lamps." "In Birmingham and Bolton, similar arrangements are being made. In those places the public lighting costs about £20,000 a year, and it is calculated that several thousand pounds will be saved." "If gas were burned by meter, it would be found that from 3 to 4 feet an hour would be ample consumption, and this would give as much light as the present lamps." Taking the amount at $3\frac{1}{2}$ feet, "this for the whole year would amount to 15,000; and, if paid for as at Reading, would amount to 50·8ths per lamp."

Mr. SHAND seconded the motion, and the same being carried, the board adjourned.

ON SULPHUR DETERMINATIONS IN COAL, COKE, &c.

By W. CROSSLEY,
Analytical Chemist, Middlesbro'-on-Tees.

[From the *Chemical News*.]

In this short article I would draw attention to the fact, that many analytical chemists, and some of them eminent men too, determine the sulphur in coke, &c., by the old process of boiling in nitric acid. This has frequently thrown a doubt on the correctness of my analysis.

A short time ago, I determined the sulphur in a sample of coke, and obtained 1·09 per cent. I found afterwards a sample of the same coke had been sent to a very eminent chemist, and he only found about ·50 per cent. Having done many previous analyses of this same coke, I made inquiry, and found he had adopted this process.

The following experiments were done to test the accuracy of the two processes,—viz., first, fusion with a mixture of nitrate of potash, chloride of sodium, and carbonate of potash; and, secondly, boiling in nitric acid. To give the nitric acid process every chance, I used a coke containing a very little sulphur :—

1. I fused one gramme of this coke with the following mixture in a platinum crucible until all the carbon had burned away :—

16 grammes of chloride of sodium
8 ,, nitrate of potash.
4 ,, carbonate ,,

The fused mass was dissolved out of the crucible with water acidified with HCl, and evaporated to dryness; the mixture was then moistened with HCl, and after adding some water, filtered, to separate the insoluble matter; the sulphuric acid was then precipitated and weighed in the usual manner.

2. I boiled another gramme of the same coke with nitric acid; evaporated to dryness; again added nitric acid, and again evaporated to dryness; the dried mass was then moistened with HCl, filtered, and the sulphuric acid determined.

The following shows the results of these two experiments :—

1. Sulphur = ·603 per cent.
2. ,, = ·477 ,,

Difference = ·126 ,,

Further, by fusion with nitrate of potash, I determined sulphur in some sulphide of iron, and afterwards made a mixture of pure carbon and this sulphide in such proportions that it contained exactly 1·26 per cent. of sulphur.

I now determined the sulphur, first, by the nitric acid process; and, secondly, by fusion. I obtained the following results :—.

1. Sulphur = ·93 per cent.
2. ,, = 1·23 ,,

Difference = ·30 ,,

I cannot exactly explain why there should be this difference. I know it has been affirmed that some of the sulphur escapes oxidation; but, where it exists in such small quantity as above, I think it can scarcely help being acted upon. Is there not rather a portion of the sulphuric acid driven off by evaporation to dryness? The following experiments seem to point to this conclusion :—

1. I boiled one gramme of the above-mentioned coke in nitric acid, to which one gramme of nitrate of potash had been added, for the purpose of uniting with the sulphuric acid formed, and thus prevent its expellation on evaporation to dryness.

2. A gramme of the mixed carbon and sulphide of iron was treated in a similar manner.

From these experiments, I obtained the following results :—

Sulphur in coke = ·604 per cent.
" mixture = 1·200 ,,

These experiments seem to support the above opinion; but it will need further experiment to determine if this be a safe process for determining sulphur.

The following table shows the results of all these experiments on both coke and mixture:—

Coke.

Sulphur by NO_5 process	=	·417 per cent.
,, fusion	=	·603 ,,
,, nitric acid, with addition of $KO.NO_5$	=	·604 ,,

Mixture.

Sulphur by NO_5 process	=	·93 per cent.
,, fusion	=	1·23 ,,
,, NO_5, with addition of $KO.NO_5$	=	1·20 ,,

I have drawn attention to the above subject, because I think it essential that chemists should be careful that they do not throw discredit on analyses by adopting incorrect processes.

REMARKS UPON THE METHOD OF OBTAINING NITROGEN BY THE DECOMPOSITION OF SOLUTION OF AMMONIA BY CHLORINE.

By Alfred Anderson,
Professor of Chemistry in Queen's College, Birmingham.

[From the *Chemical News.*]

It is stated in some treatises on chemistry* that nitrogen, in a pure state, may be obtained by the action of chlorine upon liquid ammonia; thus, by the decomposition,

$$NH_3 + 3\,Cl = 3\,HCl + N.$$

I was led to believe, however, from what I observed in making this experiment, and further, from the well-known reaction of chlorine and water,

$$Cl + HO = ClH + O,$$

that pure nitrogen would not be generated in this way, and that an abstraction of the hydrogen from a portion of the water of the ammonia solution by the chlorine, would result simultaneously with the decomposition of the ammonia itself.

When chlorine is passed into the strongest solution of ammonia, a brisk effervescence is produced, with occasionally a sharp cracking noise, attended also with a considerable evolution of heat. At the same time, a tolerably copious extrication of nitrogen takes place, always, however, containing in admixture (both at the commencement and termination of the operation) a considerable proportion of oxygen. In addition to these two gases, the only other product is chloride of ammonium, for I do not find that any chlorate of ammonia is formed throughout the process. Neither is there any of the highly explosive chlorine-nitrogen compound produced, so long as a portion of ammonia in some excess be present in the solution. If it be suffered to cool, however, when saturated with chlorine, deposition of this violent body in oily drops may speedily occur.

The mixture of the two gases, collected in a perfectly dry state, over mercury, gave on analysis the following results:—

	Bar.	Ther.	Corrected vol. at 60° and 30 in. bar.
Vol. of dry gas. 245 Mm. . .	29·75 in.	56°	244·8 Mm.
Vol. of gas after absorption of the oxygen. 215 Mm. . .	29·22 in.	56°	211·0 Mm.
			33·8 Mm.

244·8 millimètres of the nitrogen (as heretofore considered) contain, therefore, 33·8 of oxygen = 13·8 per cent.

The following equation will explain the changes occurring in this decomposition:—

$$5\,NH_3HO + 4\,Cl = 4\,NH_4Cl + N + O.$$

I may remark, that in repeating these experiments with solutions of ammonia of different degrees of saturation, I have ascertained that the proportions of oxygen and nitrogen in the evolved mixture of those gases are subject to considerable variation. But I have not found the oxygen to exceed, in any instance, the amount stated in the analysis now given; neither have I observed that any definite series of decompositions control the relative proportions of oxygen and nitrogen so obtained.

*Miller's Elements, vol. ii., p. 539.

Dr. J. Northcote Vinen's Report on the Gas Supplied by the Surrey Consumers Company:—

1862. Week ending.	Number of Observations.	Maximum Light. Candles.	Minimum Light. Candles.	Average Light. Candles.
May 10	4	12·57	12·01	12·15
,, 17	4	14·04	13·42	13·59

The volume of hydrocarbons was equal to 4 per cent.; carbonic acid to 0·50 per cent. No sulphuretted hydrogen could be detected. There were indications of the presence of ammonia on May 10, 14, and 16.

Dr. Hillier's Report for April, 1862, on the Gas Supplied by the Imperial Gas Company in St. Pancras.—The gas supplied by the Imperial Gas Company during the month of April, has been examined three times in each week, and the result of the examination has been as follows:—the lowest result obtained was, that the gas burned at the rate of 5 cubic feet per hour, and gave a light equal to 12 sperm candles. The argand burner used in this case had 15 holes, as prescribed by the Act, but they were very small ones. The highest result obtained was, that the gas gave a light equal to 15 candles; in this instance, an argand burner, with 15 holes of a larger size, was used. The average of all my obervations was to give a light of 13·9 candles. On no occasion was there any indication to test-paper of ammonia or sulphuretted hydrogen. The pressure has varied from 5 to 22/10ths of an inch.

Price Current.

CASTINGS.—*Per Ton.*

Average Weight of Cast-iron Gas-pipes, per Yard.

1¼ in.	2 in.	2½ in.	3 in	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lb.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle	Wales.	Yorkshire, Derbyshire, and Staffordshire.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Pig Iron, No. 1, G.M.B.	3 5 0	2 13 6	2 15 0	3 0 0	3 5 0
1¼ and 2-inch Socket-pipes	7 0 0	6 0 0	6 5 0	6 10 0	6 15 0
2½ and 3-inch ditto	6 10 0	5 10 0	5 15 0	6 0 0	6 5 0
5 and 5-inch ditto	6 0 0	5 0 0	5 5 0	5 10 0	5 15 0
6 inches and upwards ditto	5 15 0	4 15 0	5 0 0	5 0 0	5 10 0
Retorts, 1st fusion, hot blast	5 10 0	4 10 0	4 15 0	5 0 0	5 5 0
Ditto, 2nd ditto, cold ditto	6 10 0	5 5 0	5 10 0	6 0 0	6 5 0
Tank-plates, ⅜ thick and above	6 0 0	5 0 0	5 5 0	5 10 0	5 10 0

WROUGHT-IRON TUBING,

Subject to 40 per cent. Discount.

	2 in.	1½ in.	1¼ in.	1 in.	¾ in.	½ in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent Welded Tubes, from 2 to 12 feet—per foot	1 8	1 0	0 10	0 7	0 5	0 4½
Ditto ditto, from 6 inches to 18 inches—each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting-pieces, or Long Screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, Springs, and Elbows (wrought iron)	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, ditto	4 6	3 0	2 6	2 0	1 6	1 2
Iron Cocks	17 6	9 6	7 6	4 6	3 3	2 6
Ditto, with brass plug	28 0	15 0	13 0	7 0	5 6	4 6
Diminishing Sockets, Caps, Plugs, and Nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain Sockets	1 0	0 8	0 7	0 5	0 4	0 3
Syphons, 2-quart	15 0	14 0	13 6	13 0	12 0	—

COALS.—*Per Ton.*

Newcastle.—Unscreened.		*Scotch Cannel.*	
Whitwell Primrose	6s. 9d.	Bozhead (at Leith)	45s. 0d.
Meadowsley, Eighton Moor, and Burnhope	7 0	Kirkness, best	23 0
Pelaw	7 3	Capeldrae, 1st quality	20 0
New Pelton, Pearcth, South Pelaw, Washington Hutton, and South Pearcth	7 6	Ditto, 2nd ditto	12 6
Pelton	7 9	Lesmahago (at Glasgow)	25 0
Ramsay's Newcastle Cannel	16 0	Ditto (at Leith)	27 6
		Arniston	27 6
		Wemyss	20 0
		Knightswood	18 0
		Pirnie	14 0

FREIGHTS.

Coastwise—Newcastle.—Per Ton.		*Foreign.—Per Keel.*	
Chatham and Rochester	5s. 6d.	Barcelona	£25 0s.
Cork	8 3	Boulogne and Calais	7 10
Dover and Folkestone	5s. 9d. to 6 0	Cadiz	16 0
Dublin	8 9	Cronstadt	12 0
Exeter Quay	7 9	Copenhagen	10 0
Ipswich	5 6	Genoa	23 10
London (Pool)	5 6	Hamburg	8 5
Lowestoft and Yarmouth	4 6	Havre de Grace	8 15
Lynn	—	Leghora	23 0
Portsmouth and Southampton	9 0	Lisbon	15 10
Plymouth	7 3	Rotterdam	7 0
Shoreham	—	Stettin	11 0
Whitstable	5 6	Trieste and Venice	£22. to 24 0
Weymouth	—		

SUNDRIES.

Best Newcastle Fire-bricks—per 1000	£2. 10s. to £2 15s. 0d.
Cliff's Fire-bricks (at Wortley)—per 1000	2 15 6
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Fire-clay Retorts—per foot run	5s. 6d. to 0 7 0
Tough Cake Copper—per ton	98 0 0
English Pig Lead—per ton	20 5 0
Welsh Bar Iron (in London)—per ton	6 5 0
Foreign Spelter—per ton	18 5 0
English Block Tin—per ton	114 0 0
Banca—per ton	123 10 0
Tarred Rope Yarn—per cwt.	1 6 0

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HARPER AND MOORE,
LOWER DELPH FIRE-CLAY AND BRICK WORKS,
STOURBRIDGE,
Proprietors of
BEST CLASS HOUSE-POT, & CRUCIBLE CLAY.
Manufacturers of
FIRE-CLAY GAS-RETORTS,
of all dimensions.
LUMPS, TILES, BRICKS, &c.
Estimates given on application. Shipping Orders executed with despatch.

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Manufacturers of all sizes of Cast-Iron Main Pipes, by an improved Patent. General Ironfounders, Gas Engineers, and Wrought-Iron Tube Makers.

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NEWCASTLE-ON-TYNE & MIDDLESBRO'-ON-TEES.
Wrought and Cast Iron Pipes, Cast-Iron Retorts, and all kinds of Foundry Work necessary for Gas-Works. Fire-Bricks and Clay Retorts. Gas Coals of every description. Pig, Bar, and Plate Iron.
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12, ROYAL EXCHANGE BUILDINGS.

FOR SALE.—Eleven 7-feet lengths of CIRCULAR HYDRAULIC MAIN, 20 inches diameter; nearly new. Will be sold very cheap.

For price, &c., apply to Mr. E. S. CATHELS, Gas-Works, SHREWSBURY.

STATION-METER FOR SALE.

A STATION-METER, made by the late SAMUEL CROSLEY, to be sold. It is in perfect working order, with Clock and Tell-Tale; capable of passing, by Maker's scale, 4500, and practically, 6500 cubic feet of gas per hour. The Connexions are 6-inch.

For further particulars, apply to Mr. J. O. N. RUTTER, Gas-Works, Blackrock, BRIGHTON.

FOR SALE.—Two Second-Hand Cast-IRON DRY-LIME PURIFIERS, with Wrought-Iron Covers, 5 ft. by 3 ft. in the clear, in good condition. There are two complete sets of Lime Girds of punched plate nearly new.

Apply to ED. COCKEY and SONS, who are manufacturers of Gasholders, Purifiers, Scrubbers, Condensers, and all kinds of Gas Apparatus, and have a variety of patterns suited for Gas-Works of different sizes.

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TO GAS COMPANIES.

ON SALE, by Private Treaty, at the Gas-Works, St. Helen's, Lancashire, a STATION-METER, capable of passing 7000 cubic feet per hour, with Bye-Pass, Clock, and Tell-tale.

Reference can be made to Messrs. WEST and GREGSON, Meter Manufacturers, OLDHAM.

Apply to Mr. WILLIAM PRITCHARD, Gas Office, ST. HELEN'S.

February 18, 1862.

FOR Sale, at the Darlington Gas-WORKS, four LIME PURIFIERS, each in one casting, 6 feet diameter, 3 feet deep, six Bearers in each Box, with Hydraulic Centre-Valve, having a spare Cover, and 8-inch Connexions.

Also, one of JONES'S EXHAUSTERS, with a new Spare Wheel, and 10-inch Connexions.

The whole are in good working condition, and are being removed solely for the purpose of enlarging.

Apply to the Secretary, W. HILDRETH, jun., DARLINGTON.

THE Directors of the Daventry GASLIGHT COMPANY are prepared to receive TENDERS for providing and laying down a New 5-inch Cast-Iron Socket Pipe Main, with Lead Joints complete, in High Street, to be laid under the present foot pavement; the length about 310 yards, more or less; and all the present service-pipes to be attached to the new main, with new ¾-inch service, if required. The pavement to be relayed and made good. It will require one 6-inch T with 6-inch Outlets at starting, and the present main to be attached to it; two 5-inch T's with 4-inch Outlets; one other 5-inch T, with 2-inch Outlet. Also, three Syphon Boxes complete.

Sealed Tenders to be sent to W. BLUNDELL, Secretary to the Company, on or before the 31st day of May next, of whom further particulars may be had.

No pledge is given to accept the lowest or any Tender

SCOTCH CANNEL The MUIRKIRK CANNEL COAL is now reduced to 18s. per ton, at TROON or ARDROSSAN.

Muirkirk Iron-Works, 1862.

LEAKAGE OF GAS-MAINS
AVOIDED BY COATING WITH
YOUNG'S IRON PAINT.

This Paint has been proved, by four years test, to stand all the purposes required in Gas-Works, and has the peculiar property of drying over work previously coated with Tar.

Manufactured by J. W. YOUNG, Neath, GLAMORGANSHIRE.

Agent for London, Mr. JOHN REED, 44, Argyle Square, King's Cross, LONDON,

WHITEHOUSE and CO., Boiler and GASHOLDER MAKERS,
GLOBE PATENT TUBE WORKS, WEDNESBURY,

Beg to draw the attention of Engineers and Managers of Gas Works to the superior quality of the Article they manufacture, both in respect of the iron employed, and the perfect manner in which it is welded; in proof of which they can refer to the testimonials of the most eminent Gas Engineers, and the experience of the principal of the large Gas Companies of the kingdom.

Orders promptly executed.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

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Information as to cost, &c., supplied gratuitously upon application to the advertiser, 42, Parliament Street, WESTMINSTER. [Office of the JOURNAL OF GAS LIGHTING, &c.]

Just published, post 8vo., cloth, price 2s. 6d.,

THE Gas Consumer's Manual,
containing the
SALES OF GAS ACT OF 1859,
AND SUBSEQUENT ACTS.
By
T. L. MARRIOTT,
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GEORGE GLOVER.
LONDON:
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The Publishers beg to announce that this work, having been long out of print, has been entirely re-arranged, and the original Tables have been merged into a Treatise, entitled

A MANUAL OF HYDROLOGY.

This Book contains: DIVISION I.—Hydraulic and other Tables, with descriptive matter, and many new tables; the whole placed in a concise form.

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DIVISION III.—On Tides, Tidal Rivers, Estuaries; containing the strictest details of the conditions assumed by the tides under the varied states of the bore, and of those places where the tidal wave vanishes, also showing the effect of improvements in many of the tidal rivers of this country. Explained by tidal diagrams, sections of rivers, co-tidal lines, plates elucidating channel tides, &c., &c.

DIVISION IV.—On Rainfall and Evaporation; containing the best experiments on evaporation in various climates, tables of rainfall under every variety of elevation, period and locality. These Tables include all parts of the British Isles, France, Germany, Italy, Russia, North America, Australia, and India.

The work consists of 400 pages, and there are 20 large Plates.

Will be issued on the 14th of April, price £2. 2s.

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WILLIAM RICHARDSON
(LATE OF DUDLEY),
CONSULTING ENGINEER,
PATENTEE OF THE VERTICAL OVEN RETORT
No. 367, PERSHORE ROAD,
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References to between 100 and 200 Gas-Works Designed and Erected by the Advertiser.

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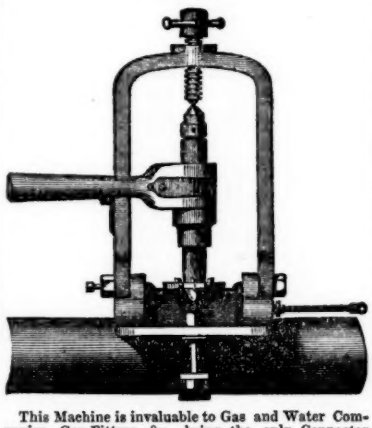
GAS ENGINEERS AND CONTRACTORS,
LINCOLN;
AND 7, JOHN STREET, ADELPHI, LONDON, W.C.

SIMMONS'S
PATENT GAS AND WATER CONNECTOR.



This Machine is invaluable to Gas and Water Companies, Gas-Fitters, &c., being the only Connector whereby accidents can be prevented. It is simple in construction, economical in saving the escape of Gas, and can be worked by a labourer.

No. 1 size, to suit ¾ and ½ in. Services, £6. 6s. each.
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Including Rachet Brace, Drills, Taps, &c., complete.

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Connectors made for fixing on the ends of Mains, to prevent escape in course of laying.

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London, March, 1862.

A. and C. MILLER, Agents for English and Welsh Gas, Steam, and House Coal Collieries. Ship, and Insurance Brokers. Gas Coals, 11s. 6d. in the Pool; drawback, 1s. per ton.

No. 9, George Yard, Lombard Street, and Coal Exchange, LONDON, E.C.

MALTA and MEDITERRANEAN GAS COMPANY, LIMITED.

NOTICE is hereby given, that the FIRST ORDINARY GENERAL MEETING of the Shareholders of this Company will be held at the London Tavern, Bishopsgate Street, on THURSDAY, the 29th inst., at Twelve o'clock precisely.

At this Meeting will be presented the Report of the Directors (containing their recommendation of a Dividend), and the Accounts of the Company for the nine months ended 31st March last.

In pursuance of the Articles of Association, the whole of the Directors and Auditors, viz.—

DIRECTORS,
EDWARD HAWKINS, Jun., Esq., Chairman.
Robinson Duckworth, Esq.
Francis Edwards, Esq.
Robert Laing, Esq.
William Nicol, Esq., M.P.
AUDITORS,
Henry M'L. Backler, Esq.
James Le Geyt Daniell, Esq.,

Will retire from office, but are Candidates for re-election.

The Transfer Books will be closed from the 22nd to the 29th inst., inclusive. E. P. ROWSELL,
May 15, 1862. Secretary.

STOURBRIDGE FIRE-CLAY WORKS.

E. BAKER and CO.
(Contractors to Government).
24 WHARF, HARROW ROAD, PADDINGTON, W.

Every article manufactured at their own Works and Mines, Brierley Hill.

FIRE-BRICKS, Lumps, Squares, Tiles, and Gas Retorts of all dimensions.
CRUCIBLE and CEMENT CLAYS.
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BUFF and ORNAMENTAL TILES.
CLINKERS and STABLE PAVINGS, noted for hardness and durability, being perfectly non-absorbent.

Shipments on the shortest notice.

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AND
GAS ENGINEERING OFFICES,
16, ADAM STREET, ADELPHI, W.C.
(*Close to the Society of Arts.*)

Mr. ANDERSON continues to Erect, or to supply the Drawings for his PATENT RETORT-SETTINGS. On this principle, three Ovens of Retorts are heated by one Coke and one Tar fire; and, for small Works, the principle is adapted to single Ovens in both cases, with a total absence of smoke, while the duration of the Retorts is from two to three years, and with great economy of fuel.

Mr. ANDERSON continues to supply his PATENT GAS-EXHAUSTER, together with Steam-Engines, &c., erected complete.

This is the most simple machine of the kind in use, being merely a double-action Pump, which any one can comprehend, and works for years without any repair.

Also, his PATENT FOUR-WAY VALVES. One of these valves does the work of three ordinary valves, when applied to Purifiers, Station-Meters, or other Gas Apparatus.

A workman cannot, by any possibility, make the mistake of shutting one passage without opening another; thus ensuring a constant flow of the gas.

All Racks, Pinions, Springs, and other delicate parts of ordinary valves, are in these valves abolished; the Connecting-pipes are also much simplified, and the cost reduced fully 30 per cent.

Also, his CONCENTRIC GOVERNOR, which stands in half the space of the ordinary Governor, and regulates the flow of Gas to the greatest nicety.

Mr. ANDERSON having five Gas-works on lease, besides being engineer to several others, has constant opportunities of perfecting his inventions before they are brought under public notice.

Mr. ANDERSON, in conjunction with Mr. STEVENS, of the Darlington Works, has recently erected and leased for a term of years, two Gas-Works of the Government, one at VICTORIA HOSPITAL, the other at the CAMP at ALDERSHOTT. At both places, the above designs are introduced, and cards to view may be had on application; as also, references to gentlemen who have used his apparatus for years.

Mr. ANDERSON may be consulted on all matters connected with the Manufacture of Gas, the Construction of new, or the reconstruction of old Works, Valuing the same, or obtaining parliamentary powers.

The Laboratory is being fitted up with apparatus for testing the chemical and photometrical properties of Coal-Gas, and also that of Meters, agreeably with the Act of Parliament. Gentlemen desirous of inquiring into such matters, are invited to pay a visit.

GEORGE CUTLER & CO.,
GAS ENGINEERS, &c.,
London Gasholder and Boiler Works,
8, WHARF, WENLOCK ROAD, CITY ROAD, N.,
LONDON.

Rye, Nov. 12, 1860.

Dear Sirs,—I consider it incumbent on me to acquaint you that the alterations recently made on the Rye Gas-Works—viz., the addition of a NEWLY-IMPROVED WASHER, and other work for the Purification of Gas, executed by the experienced workmen under your able supervision—are perfectly satisfactory to the Company, and the Gas is now as pure as it can be made.

I am, dear Sirs, your obedient servant,
CHARLES THOMAS, Superintendent,
Rye Gas-Works.
Messrs. Cutler and Co.

WALTER MABON, Engineer,
ARDWICK IRON WORKS, FAIRFIELD STREET,
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Manufacturer of
IRON TANKS for Gasholders, Railway Stations, &c.

GASHOLDERS.—Extensive premises at Gorton, solely for the manufacture of Gasholders, and other heavy Wrought-Iron Structures.

GAS APPARATUS.—W. M. has an extensive assortment of patterns for Purifiers from 4 feet to 15 feet square, also round ones from 4 feet to 10 feet diameter; Scrubbers, Condensers, Washers, Columns, Girders, and Tripod Patterns, suitable for Gasholders, from 10 feet to 150 feet diameter, either Single-lift or Telescope. Contracts for Gas-Works of any Magnitude. Designs, Specifications, and Estimates furnished.

WROUGHT and CAST IRON ROOFS for Railway Stations, Gas Works, Warehouses, and Sheds, prepared for Slates or for Corrugated Iron.

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PIPES and VALVES, for Gas and Water, from 2 inches to 48 inches bore.

ESTABLISHED 17 YEARS.

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GRATIS, and post free, "THE INVENTOR'S MANUAL;" also a pamphlet, "*L'Obtention de Patentes Anglaises;*" 500 MECHANICAL MOVEMENTS; the first part of Kinematics, or the Transformation of Motion. By JOSEPH WILLCOCK, C.E., Mem. Soc. of Eng. May be had at the above address, and of any Bookseller. Price 2s. 6d. The second part is approaching completion, and will shortly be announced.

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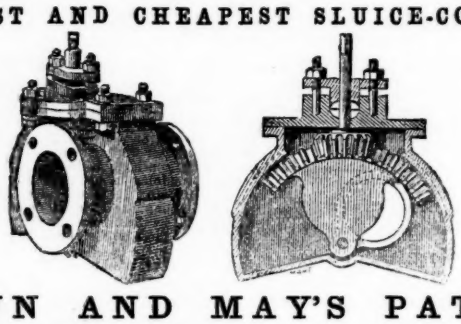
DEEPDALE FIRE-CLAY & BRICK WORKS,
Near DUDLEY,
Manufacturer of every description of Fire-Bricks, Lumps, Quarries, Shields, Flue Covers, &c., to any size or shape required.

FIRE-CLAY RETORTS,
TO MODEL OR DRAWING.

B. G. begs to call the attention of Gas Companies to his Fire-Clay Retorts, which have been used with great satisfaction in some of the largest Gas-Works in the Metropolis and many Provincial Towns in England.
References given, if required.

BEST AND CHEAPEST SLUICE-COCK.



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Above 3-inch diameter, price 10s. per inch. Brass face, 6d. eri nch extra.

Can be taken to pieces without being removed rom the line of Piping.

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Wholesale Agents, Messrs. S. and E. RANSOME, 31, Essex Street, Strand, E.C.,
Where a Sample may be seen.

COCKEY'S PATENT GAS-VALVES.

These Valves are formed of two Cast-Iron Cylinders, with segmental divisions, having the faces ground gas-tight—the upper Cylinder turning horizontally on the lower one.

The lower Cylinder has pipes from each division, communicating with the vessels to and from which the gas is to be passed. The upper Cylinder has corresponding divisions, so arranged as to direct the passage of gas to the different segmental divisions in the lower part, and, when it is turned on the face of the lower one, to alter the flow of gas from one vessel to another.

These Valves are adapted either for bye-passes; for connecting two, three, and four purifiers; or for the inlets of several Gasholders, and are in use for these purposes at the following Works:—

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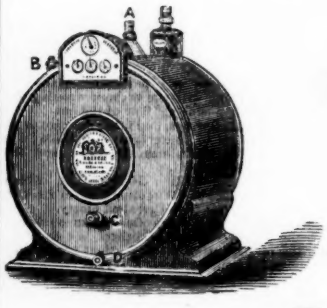
Besides many small private Gas-Works.

There are Two specimens at the International Exhibition in Class 10; one of them represents the Valve with its Index-Plate fixed for regulation, and the other shows the Valve open, exposing its passages.

IRON WORKS, FROME SELWOOD.

INTERNATIONAL EXHIBITION, 1862.



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NEW PATENT
WET GAS-METER,
AS MANUFACTURED BY
BISCHOFF, BROWN, & CO.,
Will be exhibited in Class 31 B.

An Experimental Gasholder is attached, and the advantages of the Meter illustrated with explanations.

Price-Lists for Consumers, and
STATION-METERS, EXPERIMENTAL METERS, PRESSURE-GAUGES,
AND EXPERIMENTAL APPARATUS OF EVERY DESCRIPTION,
TO BE OBTAINED AT
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PATENT DRY AND WET GAS-METER MANUFACTURER,

CRAWFORD PASSAGE, COPPICE ROW, CLERKENWELL, LONDON.

WILLIAM RICHARDS, Sole Inventor, Co-patentee, and original Manufacturer of the Dry Meter, generally known as Croll's or Glover's, and which obtained Prize Medals at the Universal Exhibition, 1851, the New York Exhibition, 1853, and the Paris Exhibition, 1855, intimates to Gas Companies, Engineers, and the Trade generally, that he has established a Manufactory at the above address for his Dry Meters; and, in soliciting the patronage of those engaged in Gas Lighting, the Advertiser can assure them that the Instruments manufactured by him are not to be surpassed. They are capable of indicating accurately the smallest possible quantity. Their flexible material is of a superior quality, which Fifteen years experience has demonstrated to excel all others for durability; and all the metals of the working parts are incorrodible.

W. R. invites the attention of those preferring the Wet Meter to his patented improvements therein, which consist in contracting the Chambers of the Measuring-Wheel, at and near the Water-Line, thus allowing of a longer range for the Float, and avoiding the sudden extinctions so common; also a simple remedy is applied to prevent the fraudulent consumption of Gas, which the operation of the recent Sales of Gas Act has so much facilitated.

The workmanship and materials are such as to leave nothing to desire.

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An indispensable Instrument to the perfect working of the Exhauster.

GOVERNORS, STATION-METERS, DRY METERS FOR PUBLIC LAMPS, &c.

WILLIAM SUGG,

MANUFACTURER OF

PATENT DRY AND WATER GAS-METERS, TEST GASHOLDERS, AND APPARATUS,

"EVANS'S" PHOTOMETERS,

Experimental Meters, Minute Clocks, &c., Station Meters and Governors,

STREET-LAMP GOVERNORS AND LAVA BURNERS,

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Established 1827.

SOLE MANUFACTURERS OF

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KAY'S PATENT HYDRAULIC VALVE GAS-METERS;

Also, DRY METERS OF THE MOST APPROVED DESCRIPTION;

All of the above being Stamped under the Provisions of the SALE OF GAS ACT.

W. and B. C. likewise supply ESSON'S PATENT COMPENSATING FOUNTAINS, and KAY'S PATENT HYDRAULIC VALVES, now so extensively used for bringing ordinary Meters within the requirements of the Act of Parliament. Gas Companies can, therefore, either attach the FOUNTAINS or VALVES to their old Meters themselves, or forward them to W. and B. C. for Alteration and Stamping.

GOVERNORS, STATION-METERS, PRESSURE-REGISTERS & GAUGES,

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NEAR NEWCASTLE-UPON-TYNE,
Manufacturer of Clay Retorts, Fire Bricks, and every description of Fire Clay Goods.

WILLIAM STEPHENSON & SONS,
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NEWCASTLE-ON-TYNE,
MANUFACTURERS OF EVERY DESCRIPTION OF
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RETORT MOUTHPIECES, BOLTS, NUTS, &c.

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PROPRIETORS OF
BEST CLASS-HOUSE POT AND CRUCIBLE CLAY.
MANUFACTURERS OF
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AMBLECOTE FIRE CLAY AND BRICK WORKS,
STOURBRIDGE.
Late in the occupation of I. and W. King. Originally J. Pidcock, Esq.
NB. A quantity of best Clay Retorts in stock, viz.—Circulars, 14 inches, 15 inches. 16 inches. D's, 16×12, 15×14, 20×16, 16×18.

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FIRE-BRICK AND TILE MERCHANTS,
Wholesale and for Exportation,
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SOUTHWARK, LONDON, S.E.,
DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for
GAS AND WATER WORKS.

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ALBERT KELLER, Ghent.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Albert Keller, of Ghent, begs to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by him. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

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WEST and GREGSON, Gas-Meter MANUFACTURERS, &c.
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Station and Experimental Meters, Gas Pressure Registers, Gauges, Experimental Gasholders, Governors, Slide Valves, &c. &c.

W. and G. would respectfully call the attention of Gas Engineers and Managers to their Station-meters, having made and erected the largest in use at the present time, two of which may be seen at the Stockport and Liverpool Gas Works, on application to the respective Engineers.

F. & C. OSLER,
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Manufactory—Broad Street, Birmingham—Established 1807,
MANUFACTURERS OF GLASS CHANDELIERS, GLASS LUSTRES, TABLE GLASS, &c. &c.

ELEGANT CRYSTAL GLASS CHANDELIERS, for GAS, from £4 upwards (Made from "REGISTERED" DESIGNS), with GLASS BRANCHES, &c.; suitable for DRAWING-ROOMS and BALL-ROOMS. The more extensive use of Gas in private dwellings has induced Messrs. OSLER to direct their particular attention to the manufacture of this class of articles—which, with a view to their general adoption, are offered at very moderate prices. Purchasers can select from a great variety of patterns, to which additions are being constantly made.

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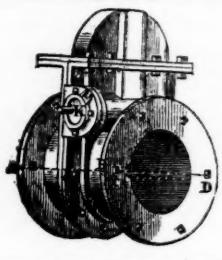

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IMPROVED GAS VALVES

from 2 inches to 18 inches, price 9s. 6d. to 12s. per inch diameter

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HOLMAN'S PATENT DOUBLE-ACTION PUMPS

Prove their general adaptation. They are adopted by
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For Pumping TAR, AMMONIACAL LIQUOR, WATER, WORT, and other fluids, their intrinsic excellence is too well known to need description.

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London Agent for Tangye's Patent Hydraulic Presses, Jacks, Lifts, Crabs, Cranes, Blocks, &c.

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HAVE BEEN
DURING THE PAST TWENTY-FIVE YEARS,
USED IN UPWARDS OF
450 BRITISH and FOREIGN GAS-WORKS.

They are made in the most SOLID, SUBSTANTIAL manner, with PLANED and SURFACED JOINTS, and SCRAPED SURFACES. They have a CLEAR, FULL BORE, in a STRAIGHT LINE of PIPE, and are TIGHT to PERFECTION.

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A Gas-Valve of each kind can be seen in the above Class. HER MAJESTY'S COMMISSIONERS selected Walkers Valves for the LIGHTING OF THE BUILDING, and the PRESSURE and SUPPLY is governed by Walkers Regulating Indicating Column and Valve, which can be SEEN IN ACTION in the the Gas-Meter Room, Austrian Court.

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Are made with FOUR GUN-METAL FACES, SCRAPED SURFACES, Gun-Metal Screws and Nuts, and are PROVED TO THREE HUNDRED POUNDS on the square inch.

They possess a most important practical improvement on the Stuffing-Box, effecting a large saving in a Water-Works Company's expenses.

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Have a CLEAR, STRAIGHT, FULL BORE, direct from the Water-Main, with NO BENDS OR BRANCHES, BALLS, OBSTRUCTIONS, OR IMPEDIMENTS of any kind to the FULL FORCE and flow of the stream of water upon a HOUSE ON FIRE.

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CRYSTAL, BRASS, AND ORMOLU CHANDELIERS;

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The PATENT GAS-REGULATOR AND PURIFIER, reduced to 6s. 6d. per dozen.

A Large Assortment of Gas Moons, Chimneys, and Reflectors, of every description, always on hand.

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A large number of **STATION-METERS,** up to 80,000 feet per hour (being by far the largest in use), and **GOVERNORS** for **MAINS,** up to 24 inches, have been constructed by Paddon and Ford. These Meters and Governors possess peculiar advantages as regards strength and freedom of action.

Sole Manufacturer of **PADDON'S PATENT STREET-LAMP REGULATORS,** for insuring any required consumption. These Regulators are in general and increasing use, and references can be given to Gas Companies who use them for every Lamp.

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Castings made in Town or Country, on the shortest notice, to Sketches, Drawings, or Patterns.

Best Animal Charcoal, for Sugar Refiners, and Case-Hardening.

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For Gas, Water, Steam, and General Purposes, and

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Originally established in 1833,

Manufacturer of Gas and other Tubes, Fittings, and articles of every description belonging to Gas, Water, or Steam.

E. D. had the honour of receiving the

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A City, containing 150,000 inhabitants,

has recently been entirely supplied with Tubes made at the above-named Works, and several others with populations nearly as great; in fact, the reputation now acquired induces this notice to the public.

Large Stocks generally on hand, averaging from one to three hundred thousand feet.

HYDRAULIC PRESS TUBES,

to resist 6000 lbs. and upwards to the square inch, extensively manufactured.

STOCK DIES and SCREWING TACKLE

of the best possible descripton.

Every Tube carefully tested with Hydraulic Pressure before leaving the Works.

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For Tanks, Roofs, Purifiers, Condensers, Erection and Alteration of Works and every description of GAS APPARATUS.

PROVIDENCE IRON WORKS,

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Main Laying and Gas-Works erected complete.

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WENLOCK IRON WHARF, 20, WHARF ROAD, CITY ROAD, LONDON,

Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water Works, including Iron Retorts, Socket and Flange Pipes, Bends, Branches, and Syphons of all sizes, Lamp Columns, &c., &c.

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Warehouse in London for Cast-iron Pipes and Connections of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

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suitable for entrances to Public Buildings, as well as ordinary street lighting, in upwards of 100 different patterns.

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IMPROVED MACHINE-MADE BURNERS

WROUGHT-IRON BATSWINGS,

FOR RAILWAY STATIONS AND MARKETS,

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BRASS AND IRON TUBES OF EVERY KIND

SUPPLIED ON THE BEST TERMS,

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GAS Stoves, Gas Baths, Gas Cooking

APPARATUS, warranted the best in England at PHILLIPS'S, the original inventor and manufacturer, and general gas-fitter, &c., 55, Skinner Street, Snow Hill, LONDON, E.C.

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Plans, Specifications, and Estimates prepared.

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PLAIN, GALVANIZED, & ENAMELLED, for Gas, Steam, and Water, from ⅛ in. to 6 in. bore.

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AND EVERY DESCRIPTION OF

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FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

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SELF-ACTING GAS GOVERNOR.

This Instrument, which is designed to replace the ordinary Governor,

Operates solely by the Action of the Gas, without any Alteration of Weights, or the Assistance of any intermediate Agency or Apparatus whatever;

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Near

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W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY,

beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.

GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

A large stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all sizes kept in London at CHRISTIE & CO.—Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

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CROSLEY & GOLDSMITH'S

PATENT SELF-ADJUSTING & COMPENSATING GAS-METERS

CANNOT BE OVER OR UNDERCHARGED WITH WATER,

and they consequently register the quantity of Gas consumed with greater accuracy than Meters in which the Water-Line is variable

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N.B. The Patent Self-Adjusting and Compensating Apparatus may be applied to the ordinary Meter.

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I. BRIGGS is also prepared to supply Gas Companies and others with

DUPLICATES of Mr. KING'S CUBIC FOOT TRANSFERRER,

similar to that manufactured by Crosley & Co., and verified by the ASTRONOMER-ROYAL, and PROFESSOR MILLER, of Cambridge, on behalf of the Government, which was deposited by them in the Office of the COMPTROLLER-GENERAL of the EXCHEQUER, before Nov. 13, 1859, in compliance with the "Act for Regulating Measures used in Sales of Gas." He also supplies

TEST GASHOLDERS,

Graduated by the Standard Cubic Foot.

TRUSS'S PATENT ELASTIC PIPE-JOINT,

FOR GAS AND WATER-MAINS, AND STEAM PIPING,

Is the only PERFECT joint that has ever been constructed, and supplies the long-felt desideratum, by allowing for the expansion and contraction of metals, and for oscillation and deflection, without impairing the joint. Gas Companies will effect an incalculable saving in adopting it, as compared with the present imperfect mode of jointing.

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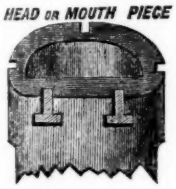
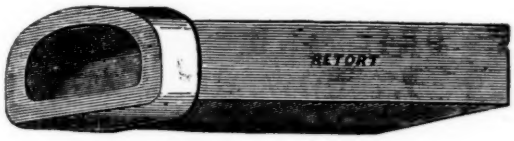
KING BROTHERS,

STOURBRIDGE FIRE-BRICK AND RETORT WORKS.





KING BROTHERS beg especially to call the attention of Gas Companies to the superiority of their Retorts, which are made from the celebrated STOURBRIDGE FIRE-CLAY. Mr. King has patented a Kiln for burning Retorts, by which Patent all Cold Air is excluded from the Kiln while burning, thus rendering them FREE FROM CRACKS AND CORRECT IN FORM. By great care in Manufacturing, combined with the advantages in burning, a VERY SMOOTH SURFACE is obtained, rendering them less liable to carbonize.

Retort Ovens, Fire-Bricks, Guards, Saddles, Rabbitted Burs, Flues, and Quarries, are all Manufactured of the same quality of Clay.

Every Retort and Brick is branded "King Brothers, Stourbridge."

FIRE-CLAY GAS RETORTS.

ESTABLISHED IN 1795.

JOSEPH CLIFF,

WORTLEY FIRE-BRICK WORKS, near LEEDS.

THESE RETORTS are unrivalled in excellence, being the BEST FINISHED INTERNALLY, and THE MOST CORRECT IN FORM, of any in the Kingdom. From the peculiar composition used in working up the face of the material, they are rendered unusually smooth, close, and FREE FROM SURFACE CRACKS, thus, in a great measure, preventing leakage and the adhesion of carbon to their interior surface.

To meet the yearly increasing demand of UPWARDS OF THIRTY SEASONS and to carry out the late improvements in the manufacture, the Premises have been re-erected and much enlarged, and Engineers may rely WITH CONFIDENCE on their orders being completed with a greater regard to despatch than by any other House.

THE WORKS ARE WELL SITUATED

For EXPORT from the Ports of { LONDON, LIVERPOOL, HULL, MIDDLESBRO', HARTLEPOOL, and STOCKTON.

FIRE-BRICKS, LUMPS, GUARDS, TILES, AND CLAY OF THE SAME QUALITY.

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CROLL, RAIT, AND CO.,

Manufacturers of Croll's Patent Improved

DRY GAS-METER,

Are prepared to supply their Meters duly stamped, under the authority of the Sale of Gas Act, 22nd and 23rd Vic., Cap. 66.

Fees for Stamping charged on Invoice.

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Of the best material and workmanship, carefully adjusted to meet the requirements of the SALES OF GAS ACT.

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WRIGHT'S REGISTERING PRESSURE-GAUGE, EXHAUSTER REGISTER, & REGULATOR;

STANDARD TEST GASHOLDERS;

Consumers' Governors; Inspectors' Pocket, King's, and all other kinds of Pressure-Gauges; Thermometers for Condensers, Pressure Registers, &c., &c.

EXPERIMENTAL TESTING APPARATUS,

Employed by the best experimenters in this country and on the continent, and by the Gas Testers in the London districts.

PHOTOMETERS, SPECIFIC GRAVITY APPARATUS, BI-SULPHURET OF CARBON TEST, THOMPSON'S BROMINE AND HEATING POWER OF FUEL TESTS, IMPROVED ALKALIMETER, EXPERIMENTAL METERS AND GOVERNORS, MINUTE CLOCKS, &c., &c.

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These METERS are GUARANTEED to meet all the Requirements of the SALE OF GAS ACT

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EXPERIMENTAL TESTING GASHOLDERS, HIGH-PRESSURE GAUGES,

AND ALL APPARATUS IN USE AT THE GAS MANUFACTORY.

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PATENTEES and MANUFACTURERS of the ONLY GOOD MERCURIAL GAS REGULATOR,

invite the attention of Gas Companies and the Trade generally to their Improved GAS-METERS, which they warrant equal to any in Quality, Workmanship, and Simplicity of Construction, and the only Meters from which Gas cannot be obtained without being duly registered.

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GAS CHANDELIERS, GLASS LUSTRES, HALL LANTERNS, VESTIBULES, BRACKETS, PENDANTS;

DOUBLE CONE, ALBERT, SHADOWLESS, & EVERY DESCRIPTION OF BURNER, UNION JETS, BATSWINGS, ETC.;

IMPROVED FULL-WAY CARTER'S VALVES (much approved of);

GAS-STOVES, and every article connected with Gas Apparatus.

CAST & WROUGHT-IRON PIPE BLACK & GALVANIZED. COPPER. TIN, BRASS, & COMPOSITION TUBING.

D. HULETT'S IMPROVED SERVICE CLEANSER

for clearing out Mains, Services, and Interior Fittings—60s. net.

Boyle's Patent Silvered Glass Combination Reflectors and Outside Lanterns.

Sole Manufacturers of Church and Mann's Photometer.

Large Pattern Books, with every description of Gas-Fittings, Chandeliers, &c., with complete Book of Prices, 12s.

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